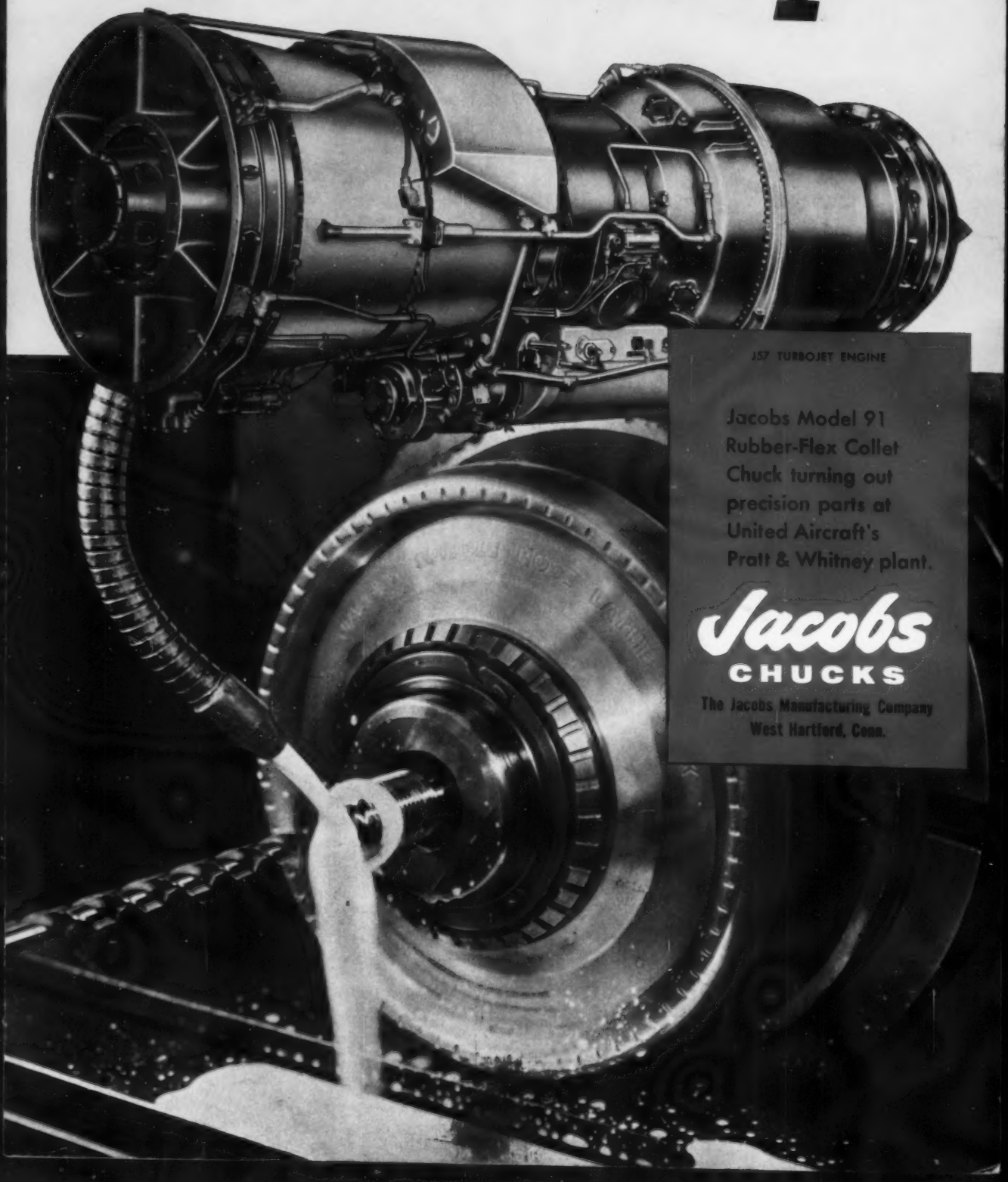
JUNE 1958 — SIXTY-FOURTH YEAR

Machinery



J57 TURBOJET ENGINE

Jacobs Model 91 Rubber-Flex Collet Chuck turning out precision parts at United Aircraft's Pratt & Whitney plant.

Jacobs CHUCKS

The Jacobs Manufacturing Company
West Hartford, Conn.

it's mainly a matter of TIMING!

But WHEN to replace a machine depends on more than its age

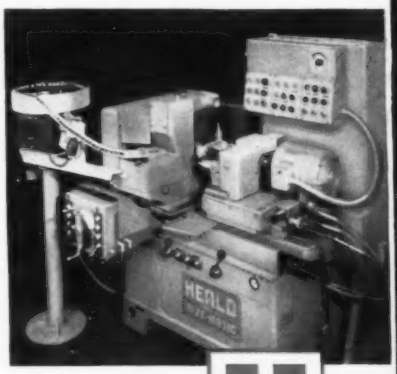
YEARS ALONE don't tell you when a machine has reached retirement age. In fact the age of a machine may be a relatively minor factor in computing the time at which it should be replaced. Some old machines may still have many years of economically productive life. While more recent ones, of a different type, may have already outlived their profitability in your plant.

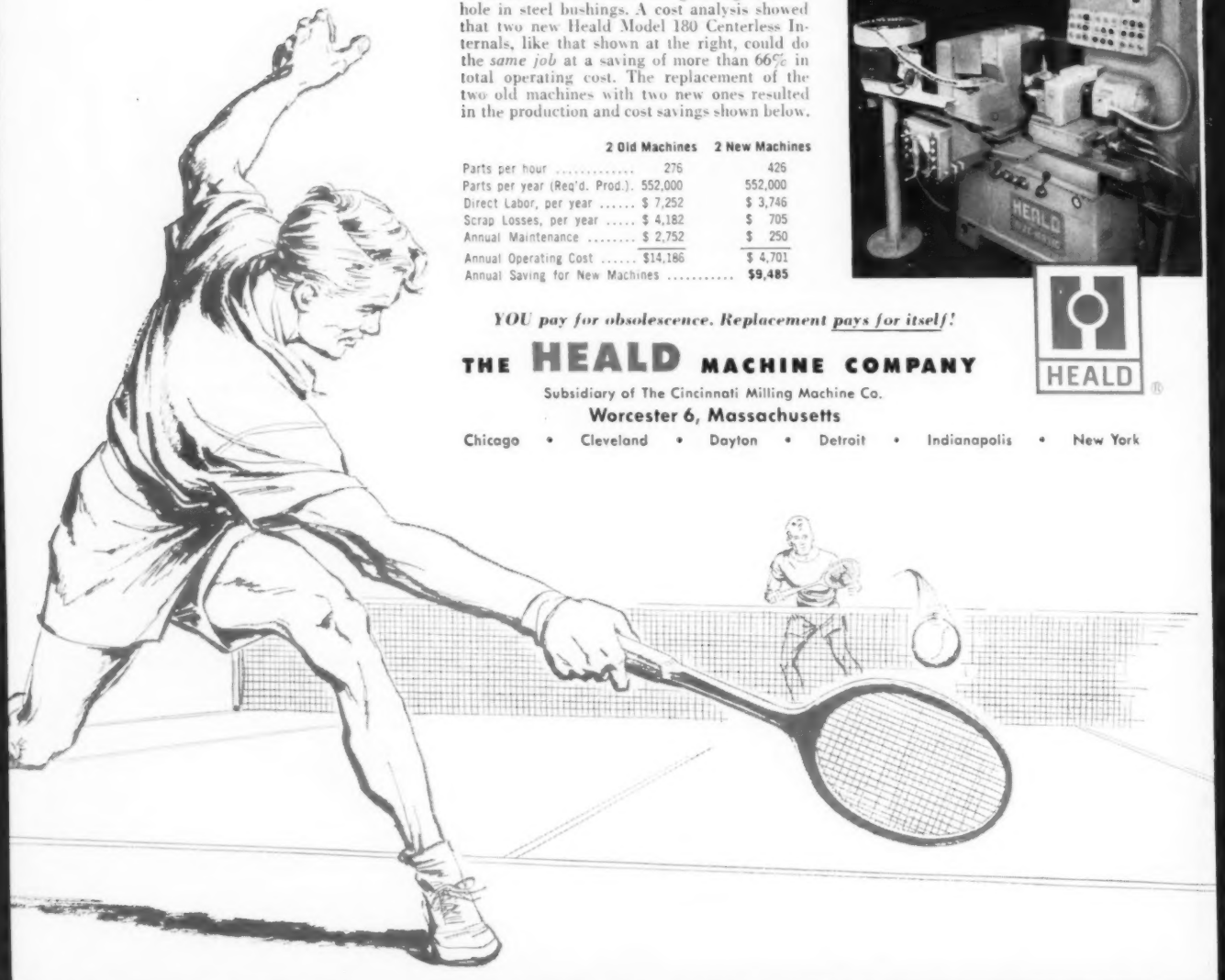
It depends on many variable factors—including the comparative efficiency of the proposed new machine, and any design improvements which will become available in the foreseeable future. But whatever the replacement conditions, proper timing can mean the difference between *profit* and *loss*. Too early is just as bad as too late. But there is *one* mathematically predictable time when replacement will cost you the least amount of money. This replacement minimum can't be determined by guesswork, intuition, or rule-of-thumb. It requires precise methods of replacement analysis, based on proved economic principles.

Our sales engineers are well experienced in making such obsolescence studies. And they will be glad to do the same for you. Similar studies by Heald engineers have pointed the way to many important *savings*.

For Example: A manufacturer of automotive parts was using two ten-year-old Heald Model 81 Centerless Internals for grinding a blind hole in steel bushings. A cost analysis showed that two new Heald Model 180 Centerless Internals, like that shown at the right, could do the *same job* at a saving of more than 66% in total operating cost. The replacement of the two old machines with two new ones resulted in the production and cost savings shown below.

	2 Old Machines	2 New Machines
Parts per hour	276	426
Parts per year (Req'd. Prod.)	552,000	552,000
Direct Labor, per year	$ 7,252	$ 3,746
Scrap Losses, per year	$ 4,182	$ 705
Annual Maintenance	$ 2,752	$ 250
Annual Operating Cost	$14,186	$ 4,701
Annual Saving for New Machines		**$9,485**





YOU pay for obsolescence. Replacement pays for itself!

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

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BPA NBP

Machinery

JUNE 1958 **VOL. 64 NO. 10**

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

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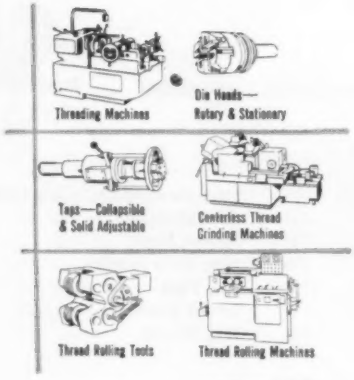
THREADING *at 581 r. p. m.*

Suburban Industries, Bensenville, Illinois, is achieving these results with a compactly-designed LANDMACO 5C Threading Machine equipped with a 5/8" VVV LANCO Hardened and Ground Die Head. Performance is not limited to one application—both steel studs and continuously-threaded bars are produced at 581 R.P.M. (76 surface feet per minute).

Chaser life is excellent. For example: 10,000 studs of B 1113 steel, having a 1/2" UN thread 3/4" in length, are produced between chaser grinds. Furthermore . . . in the continuously-threaded rod application, with 1/2" 13 pitch UN threads in 12-foot lengths, 150 bars of B 1113 steel (1800 linear feet of thread) are produced between chaser grinds. The long life between chaser grinds is the result of using a rugged LANCO die head equipped with LANDIS Tangential Chasers which can be reground for 80% of their original length.

The 5C LANDMACO Machine is manufactured in a single-spindle model for threading all diameters from 3/16" to 5/8" to Class 4 fit. The availability of lead screw feed, air-operated carriage return, air-operated carriage fronts, and special fronts for difficult-to-grip workpieces allow maximum production efficiency. Send us specifications of your workpiece and ask for Bulletin H-74 . . . let us show you how a LANDMACO Machine will handle your threading operation efficiently and economically.



LANDIS *Machine* COMPANY

WAYNESBORO • PENNSYLVANIA • U. S. A.

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

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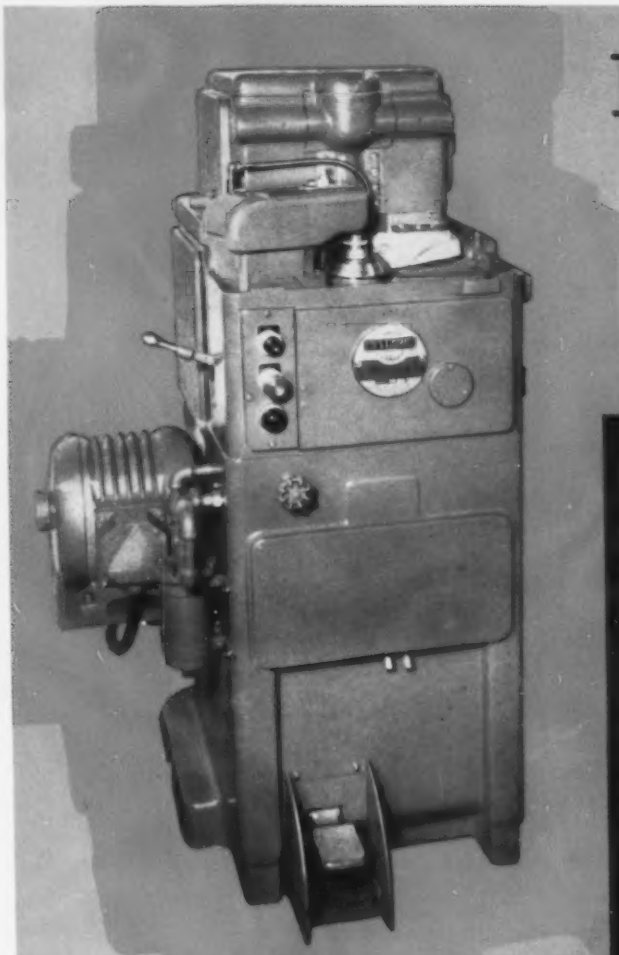
517C

LANDIS

Lowers Pinion

WITH FELLOWS



FELLOWS 3' FINE-PITCH
GEAR SHAPER

Speed and accuracy of the new 3" machine increased production of this pinion from 55 per hour to 120.

THE
PRECISION
LINE

Production Cost from 16.9¢ to 6¢ each!

FINE-PITCH PRODUCTION EQUIPMENT

Fellows No. 4 Fine-Pitch Red Liner Inspection Instrument gives proof of accuracy.

Here's an example that shows how Fellows machines pay off in lowered gear production costs. This small pinion is manufactured for a major instrument maker on a Fellows 3″ Fine-Pitch Gear Shaper.

Production is 120 pinions per hour, more than twice the production of previous machines. In addition, pieces are automatically deburred, eliminating an operation. *Result:* the cost per pinion is 10.9 cents lower than before!

Fellows 3″ Fine-Pitch Gear Shaper cuts within close tolerances at speeds up to 2,000 strokes per minute. The Fellows No. 4 Fine-Pitch Red Liner inspection instrument gives chart-recorded, permanent proof of the accuracy of the product.

For full information about the Fellows Precision Line of gear production equipment—from 1/16″ P.D. to 120″ P.D.—contact your Fellows representative. Write, wire, or phone any Fellows office.

THE FELLOWS GEAR SHAPER COMPANY,
78 River Street, Springfield, Vermont.
Branch Offices:
1048 No. Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Ave., Chicago 39
6214 West Manchester Ave., Los Angeles 45

Fellows *Gear Production Equipment*

meet

New CINCINNATI No. 1D Toolmaster Milling Machine. Catalog No. M-2017. Other styles: 1A, 1B and 1C; catalog No. M-1870-4.

CINCINNATI

CINCINNATI®

MILLING MACHINES • BROACHING MACHINES • CUTTER
METAL FORMING MACHINES • HARDENING MACHINES •

For more information fill in page number on Inquiry Card, on page 179

1-D..newest member of the CINCINNATI TOOLMASTER Family

Hundreds of CINCINNATI Toolmaster Milling Machines — the familiar 1A, 1B and 1C styles — are giving an excellent account of themselves in shops throughout the country. And now the new 1D Toolmaster extends the versatility of this fine family of machine tools still further. Exclusive 1D features and advantages include:

Infinitely variable spindle speeds, 100-3800 rpm

Instant selection of spindle speeds . . . through a control lever on front of the spindle head

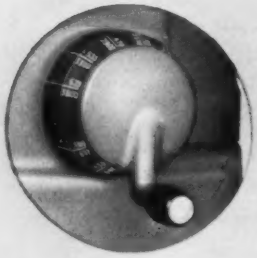
1½ hp spindle drive . . . and it's all usable

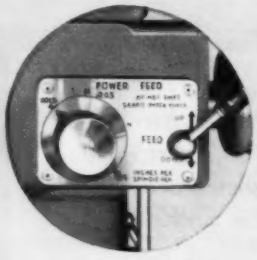
No. 40 standard taper hole in spindle . . . and positive key drive for arbors and collets

Power quill feed (extra) . . . up and down; three feed rates; power trip-out

These and other features and advantages give 1D Toolmasters the highest performance rating for reducing the cost of vertical and angular milling operations, and, with additional equipment, boring and shaping operations as well. Now's the time to replace your worn out ¾ to 1½ hp milling machines with new CINCINNATI Toolmasters. Complete information in attractive catalogs. May we send copies to you?

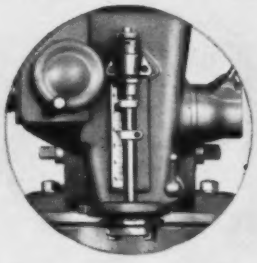
Spindle speeds are changed instantly. Merely select the high or low range and then rotate this control lever to the speed desired. Speeds are dial indicated.

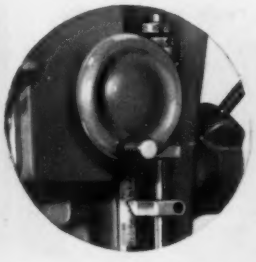




For boring and drilling operations, you'll want power feed to quill, at slight extra cost. Three feed rates; knob selected; up and down; .0015", .003" and .006" per rev.

Precision quill depth gage accurately positions the quill where you want it. The device is located where it's most convenient for the operator . . . on front of the spindle head.





Quill feed handwheel, mounted on front of the spindle head, advances the quill in fine feed progression. A lever on the right-hand side quickly advances or retracts the quill.

AND TOOL GRINDERS • SPECIAL MACHINE TOOLS
CUTTING FLUIDS • GRINDING WHEELS

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO

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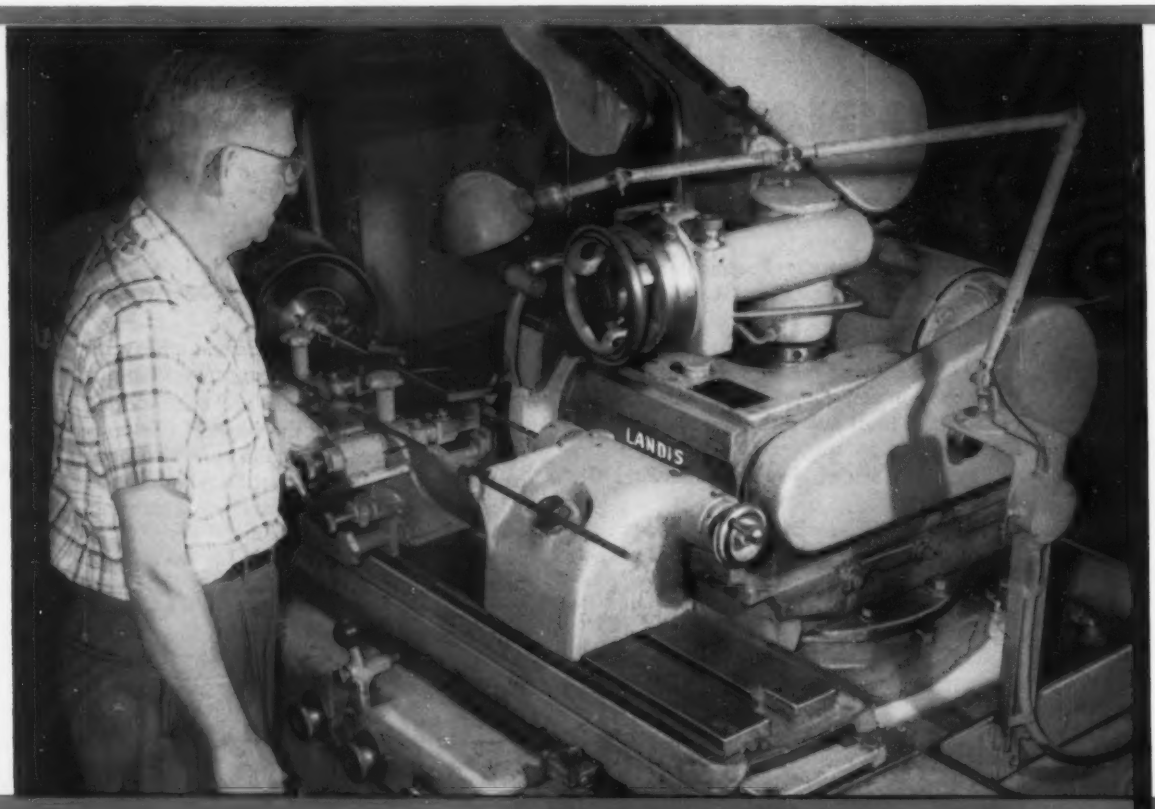
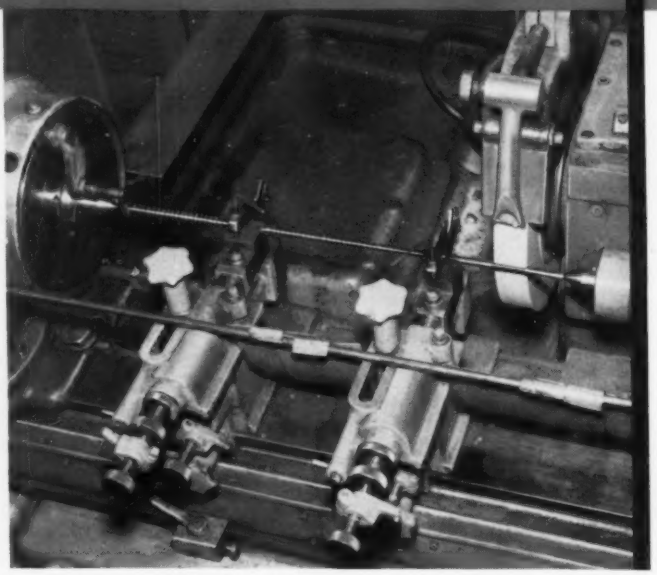
Landis universals demonstrate versatility



A well known manufacturer of automotive electrical components uses this Landis 12" x 36" Type CH Universal grinder in the toolroom. This shows one of the many jobs ground on this machine.

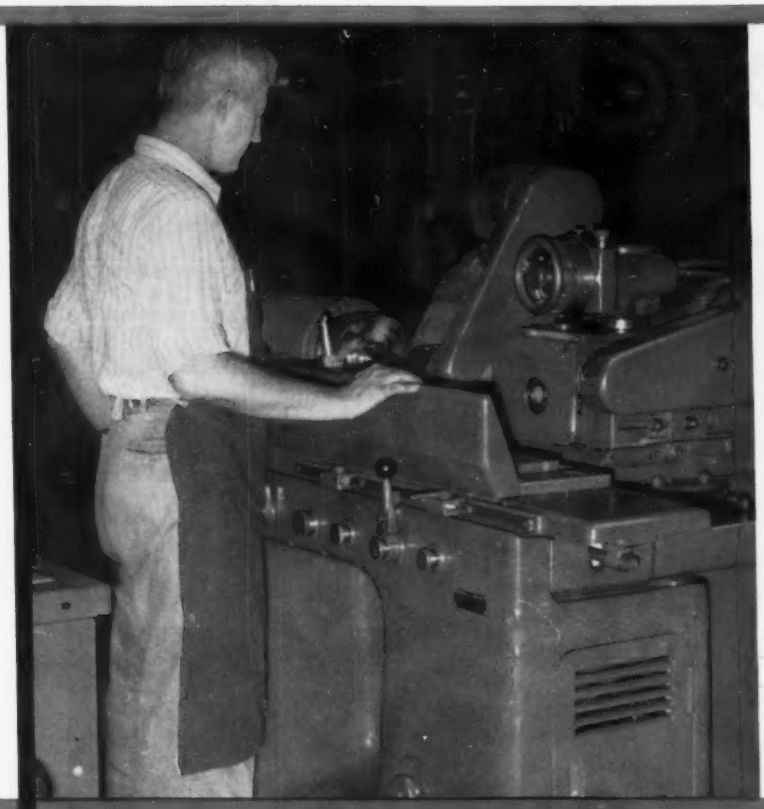
Broken broach repaired by grinding welded new shank to match the original shank. Work rests support the long, slender workpiece.



LANDIS
precision grinders

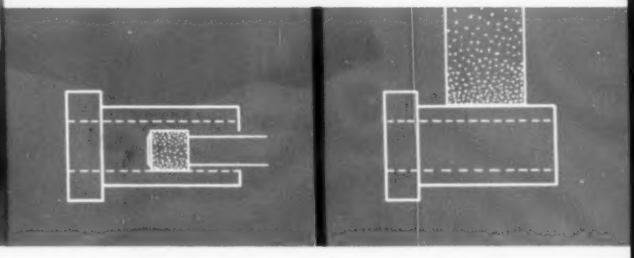
LANDIS TOOL COMPANY

in profitable grinding operations



A west coast machinery manufacturer uses his Landis 10" x 20" Type H Universal to grind a wide variety of parts in small lots. Where set-ups are frequent, the convenience and flexibility of this Landis Universal saves time and raises production considerably.

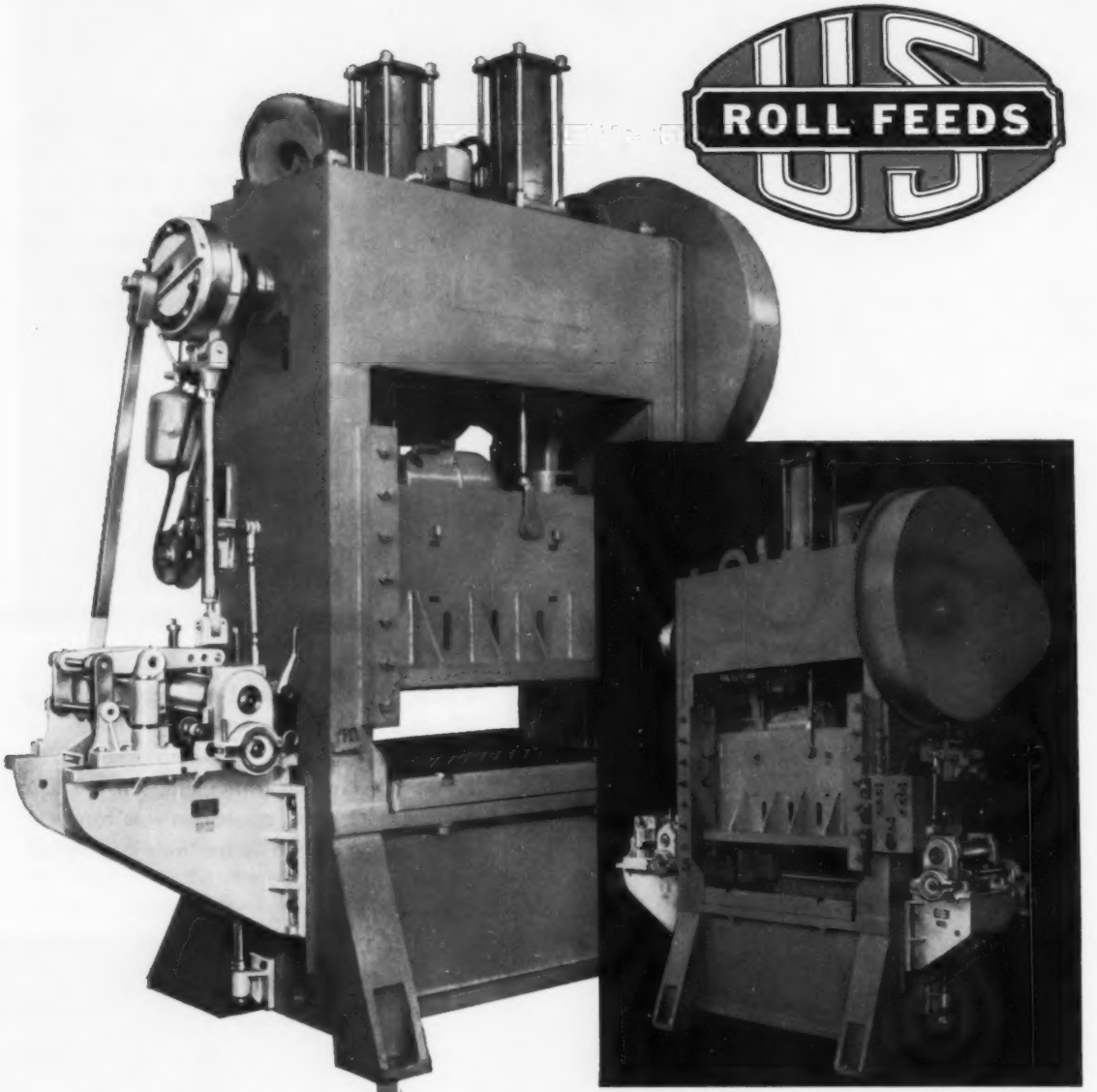
Cycle time cut in half—grinding the I.D. and O.D. in one chucking. Drill bushings are shown here being ground to .0005" tolerance with .015" to .020" stock removal. This operation was formerly done on an engine lathe with a grinding attachment.



WAYNESBORO, PENNSYLVANIA

FOR CONSISTENT PERFORMANCE

U.S. Style "B"



U. S. Style "B" double Roll Feed Model No. RF-1212, with scrap chopper mounted on a modern straight side press. This particular installation handles stock widths up to 12", with feed length adaptable up to 12".

Roll Feeds

The introduction of U. S. Tool Company Style "B" Roll Feeds brings to your Press-Room a new line of Rack and Pinion Roll Feeds in a range of sizes to keep pace with most production requirements.

U. S. Style "B" Roll Feeds are made in both double and single types, with bolster plate for O.B.I. presses or with adjustable mounting brackets for straight side presses.

All Style "B" Roll Feeds are equipped with hardened and ground rolls of hollow construction, which are driven by hardened spiral gears running in oil. These gears are mounted in an enclosed housing. The roll-pin type over-running clutch has carbide inserts. Standard equipment also includes manual roll lifters; self-equalizing brakes; two-piece adjustable driving eccentric to simplify timing the feed in relation to the motion of the ram of the press; stock oiler and eccentric operated scrap chopper. Automatic roll lifters are available in either ram operated or adjustable eccentric operated types.

For full information regarding the U. S. Style "B" Roll Feeds write for your copy of Bulletin 85-M.

Rear View: Showing the rack and pinion mechanism and cross members for actuating the entering feed and eccentric operated roll lifters. One of 5 models of U. S. Style "B" Roll Feeds will fit your Press Room equipment.

US PRODUCTS

- Slide Feeds
- Roll Feeds
- Stock Straighteners
- Stock Reels
- Stock Oilers
- Coil Cradles
- Wire Straighteners
- Die Sets
- Multi-Slides®
- Multi-Millers®

U. S. TOOL COMPANY, INC.

AMPERE *(East Orange)* NEW JERSEY

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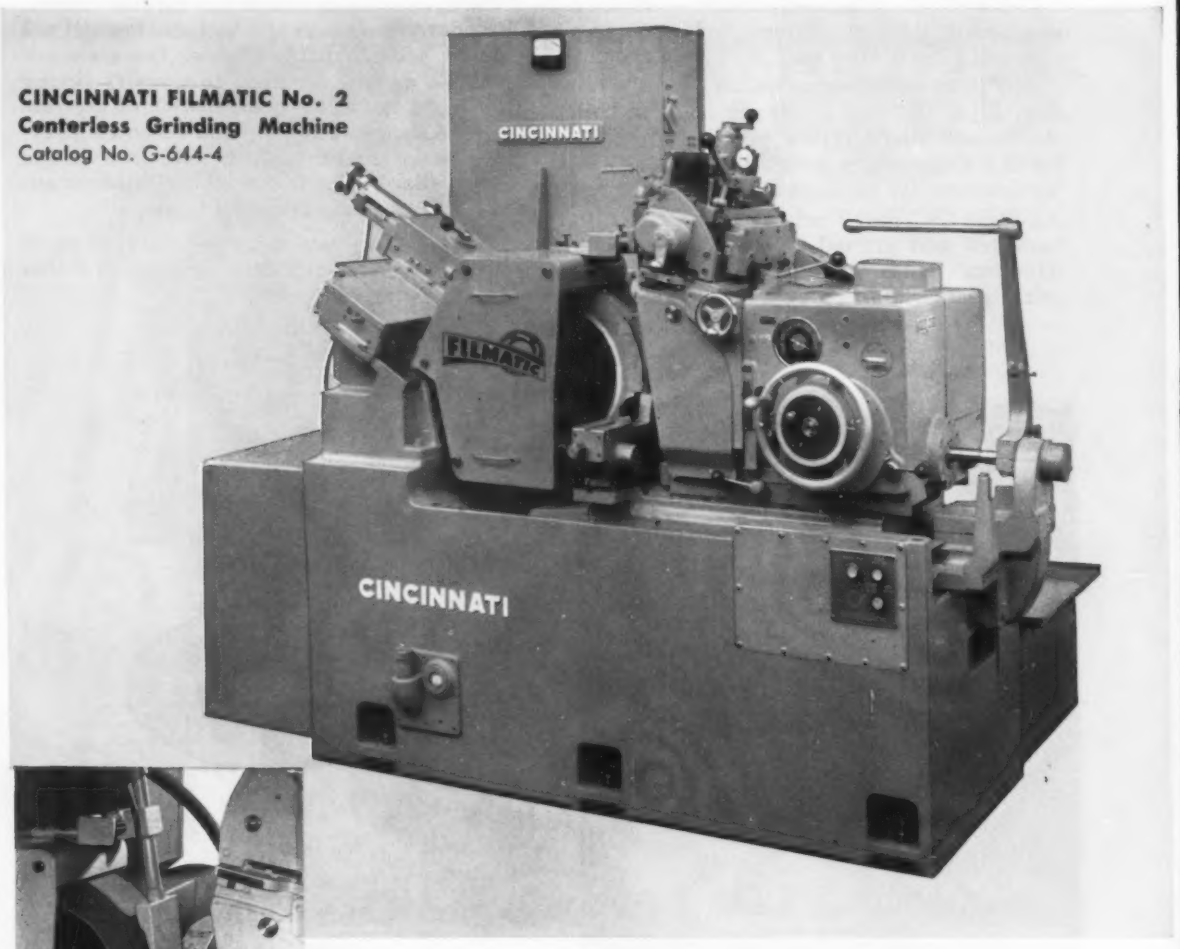
NEW FEATURES ...NEW ADVANTAGES

Incorporated in the World's Finest Centerless Grinder...

CINCINNATI FILMATIC No. 2
Centerless Grinding Machine
Catalog No. G-644-4



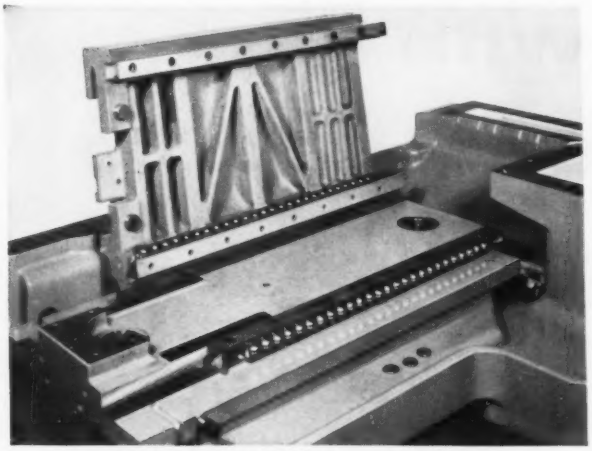
New cutting fluid control . . . the nozzle, the supporting bracket, the wheel guard . . . for more efficient use of cutting fluid. Dial indicator base (extra) for aligning workrest blade.

FILMATIC grinding wheel spindle bearings just never wear out or require adjustment.

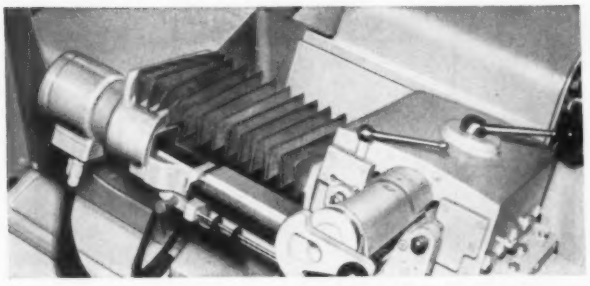
CINCINNATI®

CENTERTYPE GRINDING MACHINES • CENTERLESS GRINDING
ROLL GRINDING MACHINES • SURFACE GRINDING MACHINES •

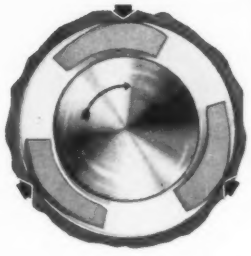
Cincinnati Filmatic no. 2



Anti-friction bearing slide, one of the biggest improvements in centerless grinding within the past few years, eliminates stick-slip and scoring.



Grinding wheel truing unit incorporates several features of high quality construction, including bellows dust guard to protect the ways and hydraulic motor to actuate the unit.



Get acquainted with the new features incorporated in CINCINNATI FILMATIC No. 2 Centerless Grinders! You'll find that these machines now have a higher cost-reducing potential than ever before. ¶For improved truing action, the grinding wheel truing unit is mounted at an angle of 30°, and controls are located directly below and at the rear of the unit, right where the operator stands when truing the wheel. To facilitate alignment of the work blade, the workrest mounting pad now has a parallel slot for a dial indicator bracket. Short operators will like the adjustable ejector limit switch*, which ejects the work when using a partial arc of infeed lever movement. Also, new cutting fluid control and nozzle for work . . . new cutting fluid control for diamond . . . bed 5" longer for ample support of new truing units . . . greater throat clearance accommodates larger regulating wheel (13" diam.) . . . both swivel adjusting screws (for correcting taper in work) located on front of machine. ¶ These new features and advantages are in addition to the reliable standbys such as FILMATIC grinding wheel spindle bearings; anti-friction infeed slide; infinitely variable regulating wheel speeds, and many more. Get a copy of catalog No. G-644-4, and you'll see why CINCINNATI FILMATIC No. 2 Centerless Grinders are the finest machines available for replacement or additional equipment.

*extra with automatic ejector

CINCINNATI

MACHINES • MICRO-CENTRIC GRINDING MACHINES
CHUCKING GRINDERS • CENTERLESS LAPPING MACHINES

CINCINNATI GRINDERS INCORPORATED
CINCINNATI 9, OHIO

Are your machine tools short-changing you?

this G&L with Dupli-Tracer can double machine productivity!

Unequalled machining versatility is achieved by G&L HYPRO Heavy Vertical Boring and Turning Mills equipped with either the *G&L Dupli-Tracer* or the *G&L Numericord*

Astounding—but true! Here's one of the most versatile and productive machine and control combinations ever engineered. It's a *G&L HYPRO* Heavy Vertical Boring Mill equipped with a choice of two independent and remarkably flexible *G&L* control systems.

One control system is the *G&L* electronic *"Dupli-Tracer"* for 2 dimensional, stepless contour tracing.

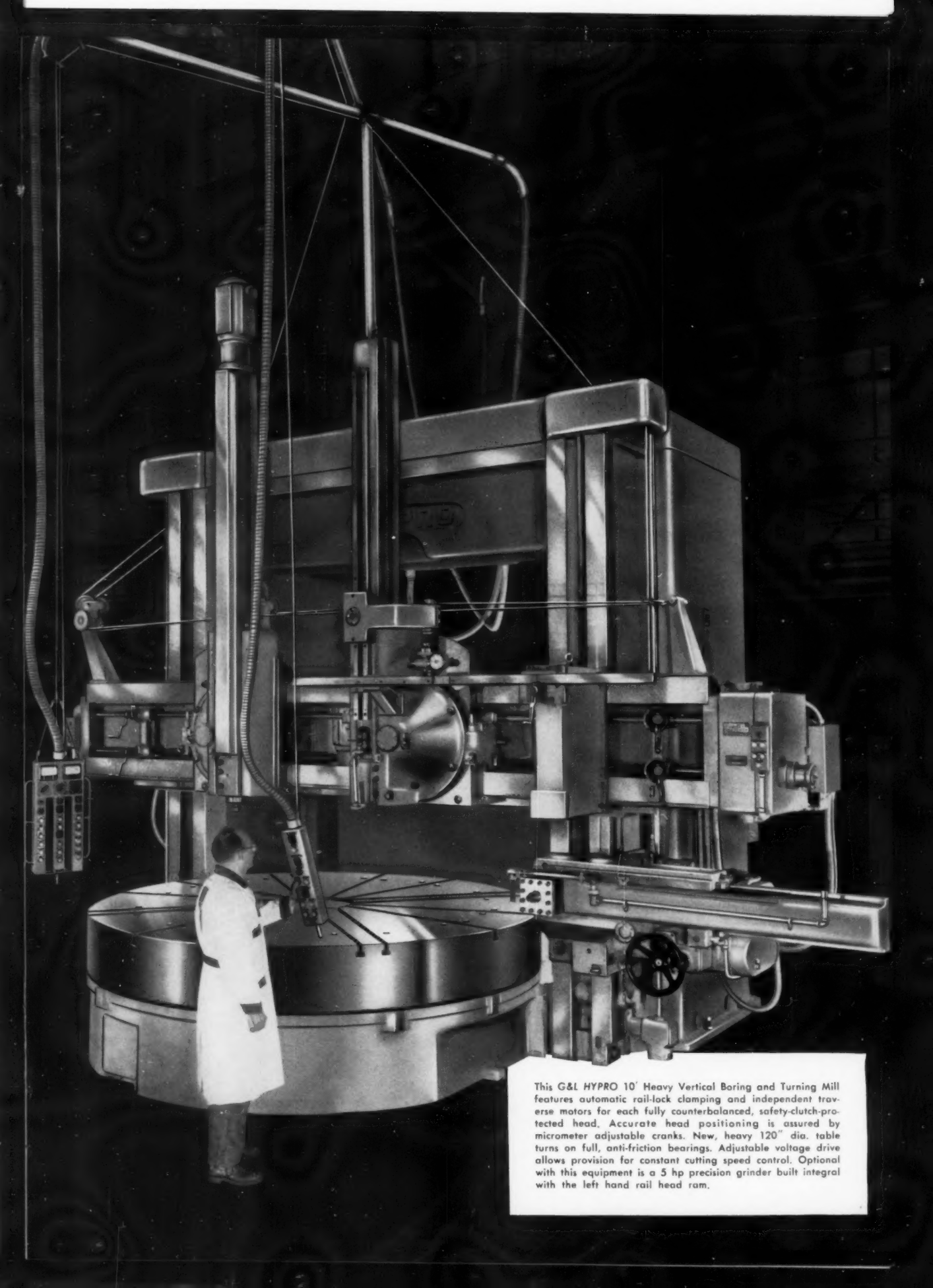
The other available system—*G&L's NUMERICORD* continuous-path tape control — virtually eliminates non-cutting intervals and reproduces parts without error. No templates are needed. Productivity can be doubled or even tripled! Every tape is an invaluable storehouse of engineering skills and job machining methods.

For further machine details, on 54" through 12' sizes, plus profit-making optional arrangements and control data, see your nearest *G&L* representative or write direct.

G&L *and* HYPRO DIVISION
GIDDINGS & LEWIS MACHINE TOOL CO.
FOND DU LAC, WISCONSIN G-93

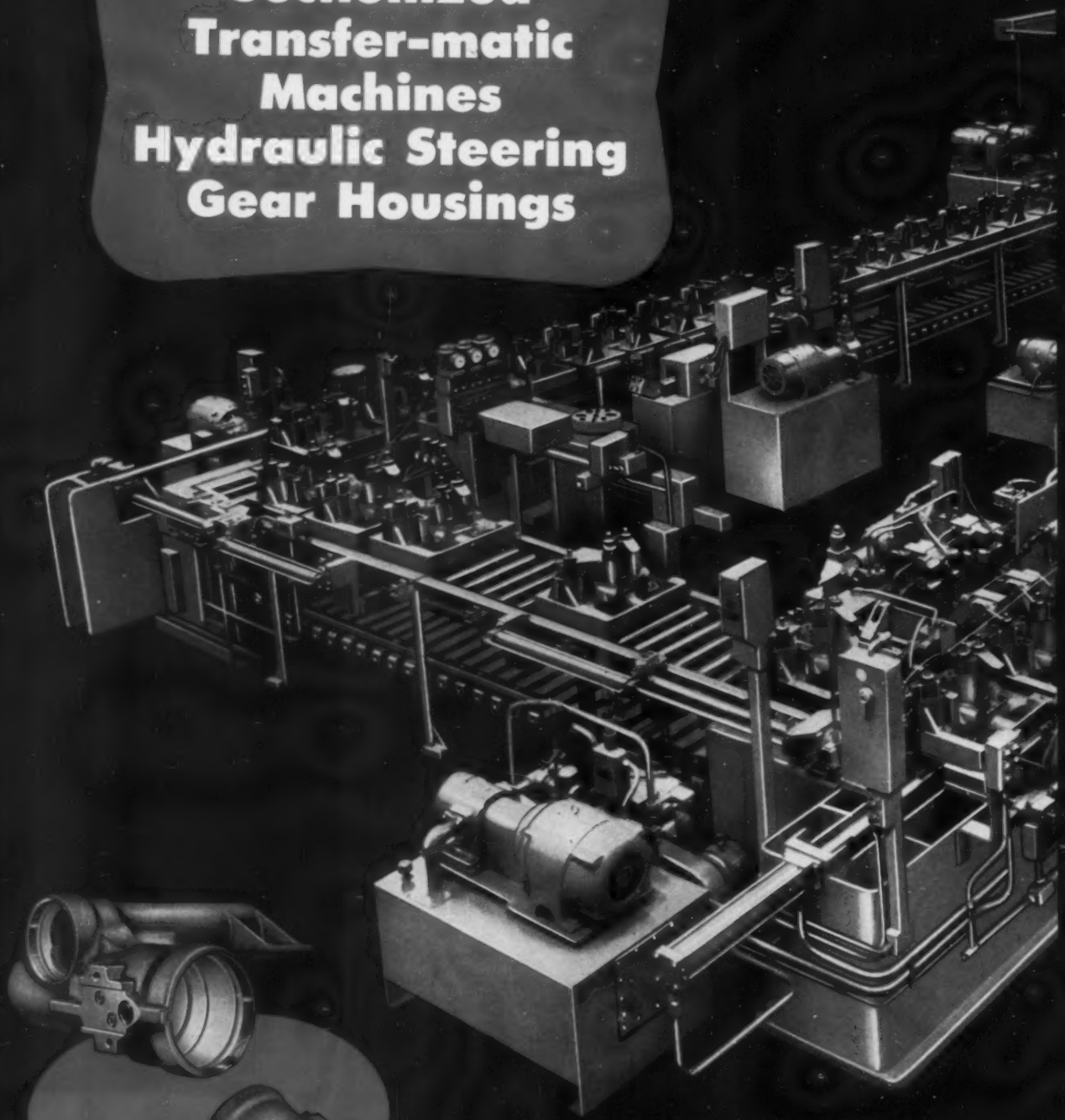
Builders of the world's finest heavy-duty Table, Floor and Planer Type Horizontal Boring, Drilling and Milling Machines; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines; Vertical Boring and Turning Mills; Spar and Skin Milling Machines; VARIAX Milling Machines and NUMERICORD numerical continuous-path tape controls.

For more information fill in page number on Inquiry Card, on page 179



This G&L *HYPRO* 10' Heavy Vertical Boring and Turning Mill features automatic rail-lock clamping and independent traverse motors for each fully counterbalanced, safety-clutch-protected head. Accurate head positioning is assured by micrometer adjustable cranks. New, heavy 120" dia. table turns on full, anti-friction bearings. Adjustable voltage drive allows provision for constant cutting speed control. Optional with this equipment is a 5 hp precision grinder built integral with the left hand rail head ram.

Sectionized Transfer-matic Machines Hydraulic Steering Gear Housings



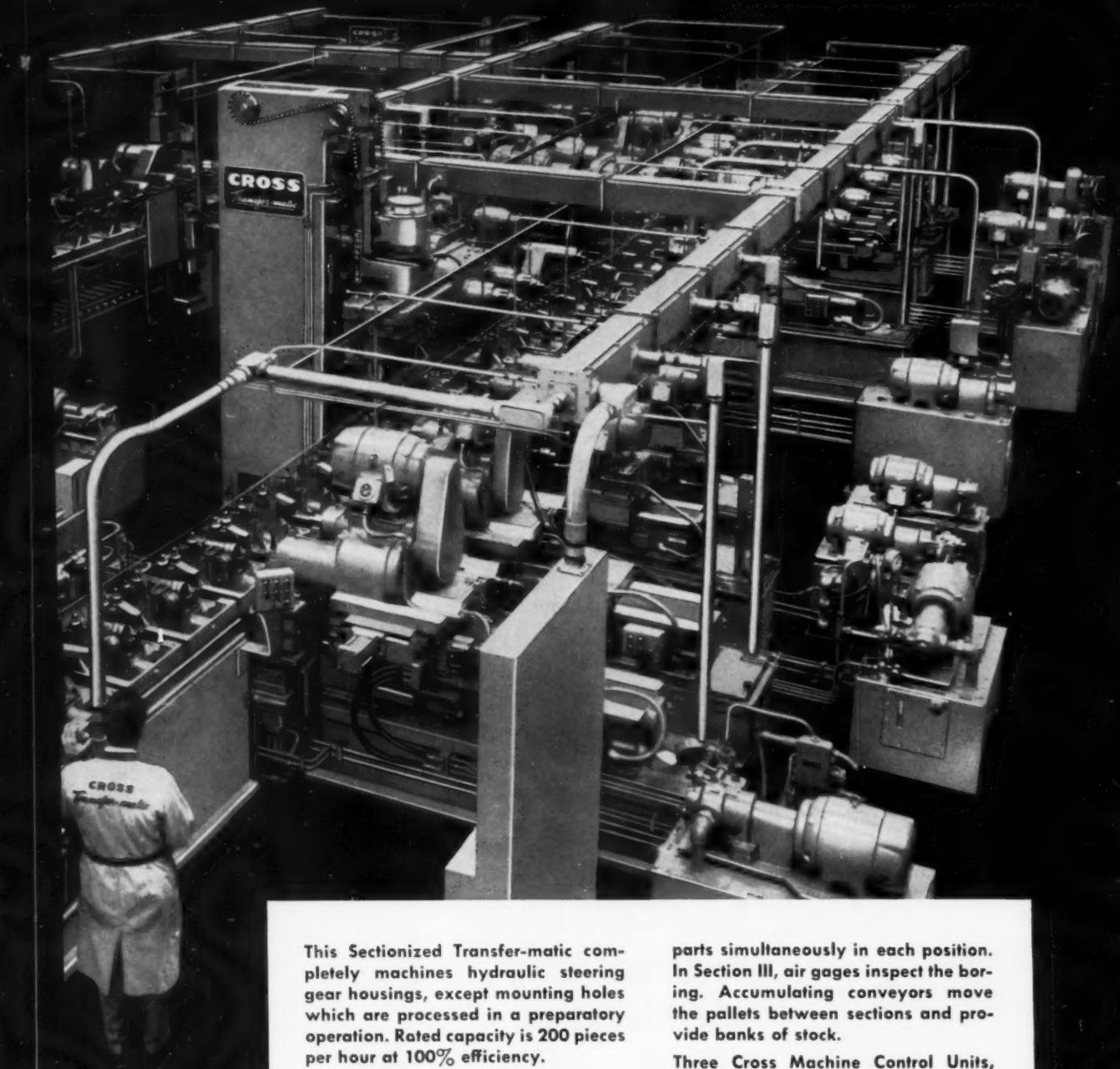
Established 1898

THE CROSS CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

Another Automation First by Cross



This Sectionized Transfer-matic completely machines hydraulic steering gear housings, except mounting holes which are processed in a preparatory operation. Rated capacity is 200 pieces per hour at 100% efficiency.

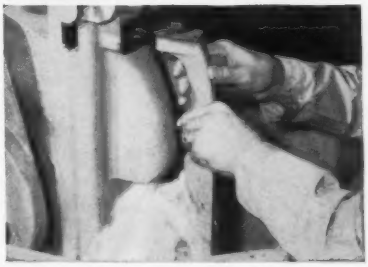
The housings are power clamped to pallet work holding fixtures which are transferred through three machine sections. In Section I, housings are milled, drilled, reamed, spotfaced, tapped and rough bored. Fixture clamps are then released to relieve machining strains. In Section II, single point precision boring completes the machining. Production is balanced by boring four parts simultaneously in each position. In Section III, air gages inspect the boring. Accumulating conveyors move the pallets between sections and provide banks of stock.

Three Cross Machine Control Units, with Toolometers to program tool changes, minimize downtime. Tool setting fixtures are provided to pre-set tools, thus eliminating trial cuts and adjustments.

Other features are complete interchangeability of all standard and special parts for easy maintenance, construction to JIC Standards, hardened and ground ways, and automatic lubrication.

Fishing for

Norton K† Bond CRYSTOLON* wheels bring big advantages to offhand grinding



Here's a combination of vitrified bond and silicon carbide abrasive that delivers remarkable results — particularly in offhand sharpening of single-point carbide tools. You can get these wheels in dense, medium, or porous structure — for most efficient action regardless of the area of contact.

Also, CRYSTOLON abrasive is made in green or gray types—green, 39C, being first choice in a majority of carbide applications.

In addition, half-grade increments of hardness are available, enabling us to "pin-point" wheel specifications to minimize your grinding costs.

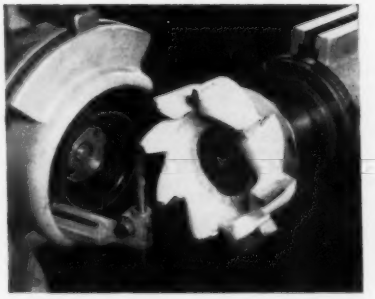
And the Norton K Bond is one of the most radically improved vitrified bonds ever developed. One big advantage is: *it assures closest possible duplication of wheel specifications.* Which means that every time you reorder K Bond wheels you get exactly the same top performance.

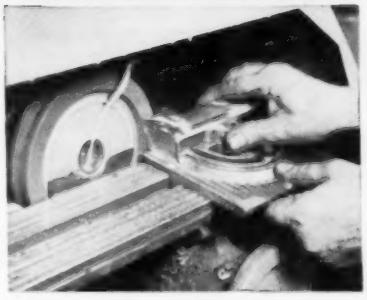
carbide grinding economies?

Catch 'em all fast— with the finest lures made

You cut grinding costs to rock bottom with Norton's outstanding wheel selection and service

Norton Diamond Wheels, mined or man-made . . . carbide grinding's Certified Crown Jewels





Norton was first to introduce all three bond types of diamond wheels: resinoid, vitrified and metal . . . does all its own checking and sizing of diamonds . . . duplicates wheel specifications with constant accuracy.

Resinoid bonded wheels are best for such jobs as precision grinding of cutters, form tools and die blanks. These wheels are available in several resinoid bond types — B type for wet grinding — B6 type for dry grinding.

Vitrified bonded wheels are used for sharpening single-point cutting tools, grinding chip grinders and for surfacing carbide dies.

Metal bonded wheels are sometimes preferred for grinding chip breakers, for certain offhand grinding jobs, and for cutting off sintered carbide blanks, etc.

Norton leadership in diamond wheel manufacture continues whether the diamonds used are natural or man-made. And with each Norton diamond wheel you get a certificate of diamond concentration. Signed by the President of the Company, this certificate is your safest possible buying guide.

W-1843

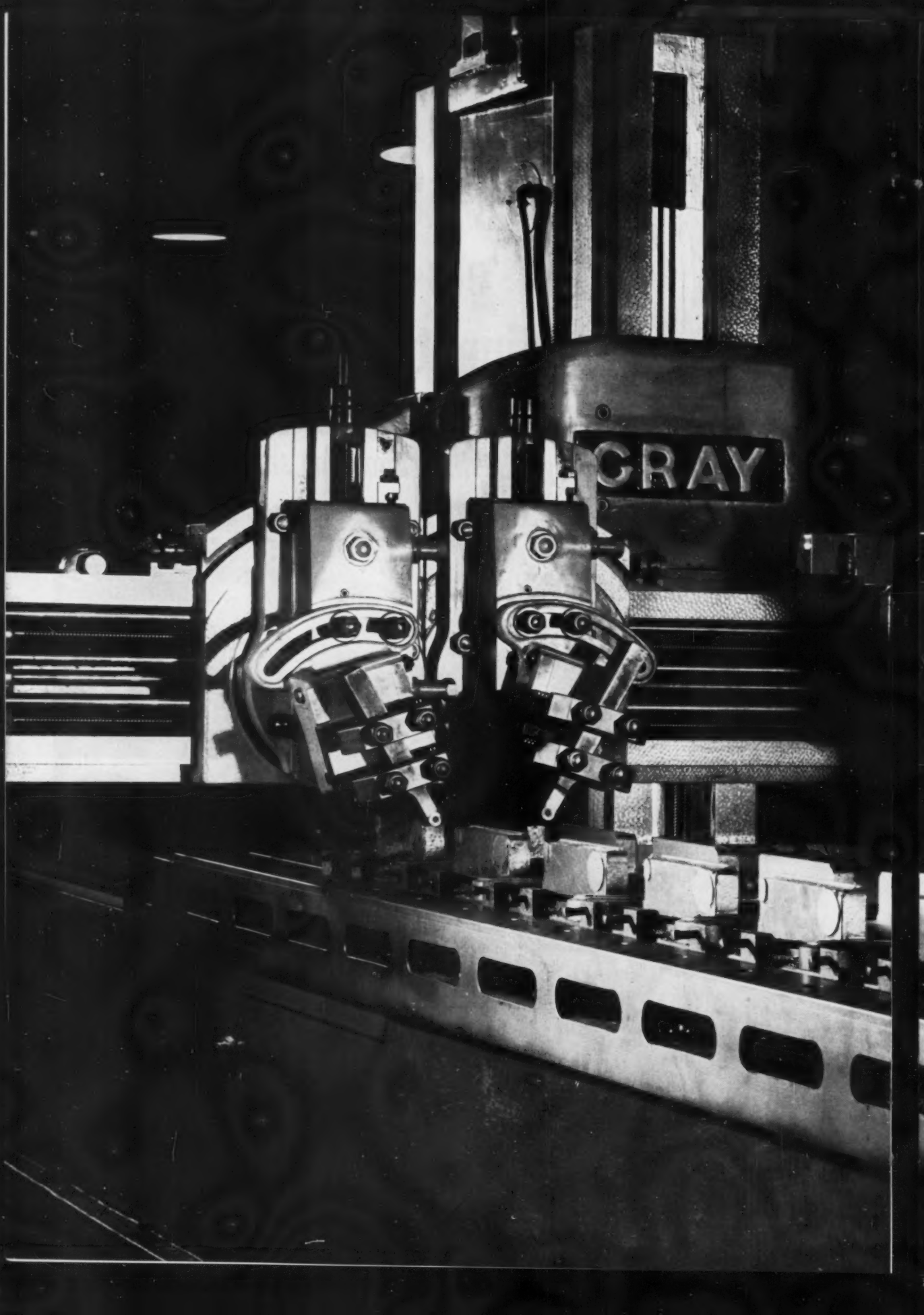
The Complete Line, Completely Serviced

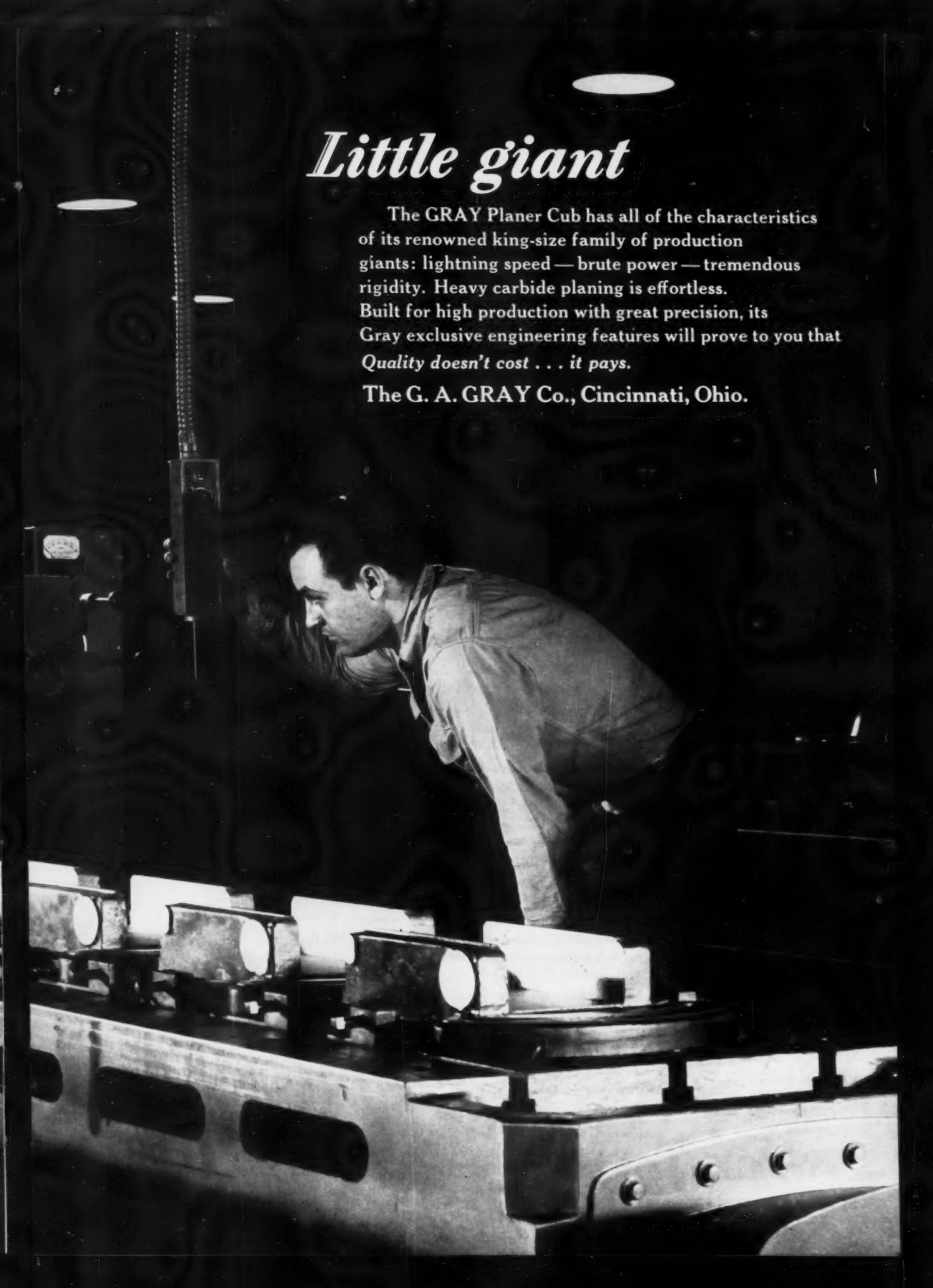
Norton not only supplies the most extensive line of wheels for carbide grinding. As the world's largest producers of abrasives it maintains the most modern equipment designed for product quality control. Expert engineering assistance and prompt deliveries are also geared to provide the wheels you need for top quality, lowest cost carbide grinding. For these helpful services, see your Norton Abrasive Engineer or Distributor. Or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

NORTON
ABRASIVES
Making better products... to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — **BEHR-MANNING DIVISION** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries †Patent applied for


GRAY


Little giant
The GRAY Planer Cub has all of the characteristics of its renowned king-size family of production giants: lightning speed — brute power — tremendous rigidity. Heavy carbide planing is effortless. Built for high production with great precision, its Gray exclusive engineering features will prove to you that
Quality doesn't cost . . . it pays.
The G. A. GRAY Co., Cincinnati, Ohio.

Don't throw away those epoxy-coated rejects

Here's a new paint stripper that will save them

Do you scrap perfect metal parts that have been imperfectly coated with epoxies, vinyls, polyesters and other hard-to-strip paints or lacquers?

In the last few months, users of Oakite Stripper S-A have eliminated many such losses. Here's what some of them say about it:

CALIFORNIA: An aircraft manufacturer tested many strippers on an epoxy designed to resist attack by hydraulic fluid. Finally found that Oakite Stripper S-A is "the only one that safely strips this paint from anodized aluminum."

NEW YORK: A camera maker coats flash bulb reflectors with black vinyl paint outside and aluminum paint inside. "Stripper S-A is the fastest ever used on our rejects."

OHIO: A maker of toy pistols had trouble stripping alternate coats of lacquer and metallized aluminum. Now "Stripper S-A does it amazingly fast and remetallizing is completely satisfactory."

CALIFORNIA: A producer of metal furniture uses Stripper S-A to remove clear epoxy from plated parts. Chemist says "This is the best stripper on the market."

ALABAMA: A hardware maker had trouble stripping lacquer from brass door knobs. Oakite Stripper S-A now does the work in "less than ⅓ the time taken by any other stripper."

NEW YORK: A manufacturer of business machines tested several strippers on various finishes on steel and aluminum. Verdict in favor of Stripper S-A was: "It's doing a wonderful job."

CONNECTICUT: A maker of brass lipstick shells has found that "Stripper S-A quickly strips epoxy lacquers from rejects and heavily coated work spindles."

CALIFORNIA: A missile maker reports that "Stripper S-A is doing a fine job stripping vinyl from stainless steel and titanium."

FREE Write Oakite Products, Inc., 26 Rector St., New York 6, N. Y., for complete information on Oakite Stripper S-A.

In our 50th year.

OAKITE

SCIENCE

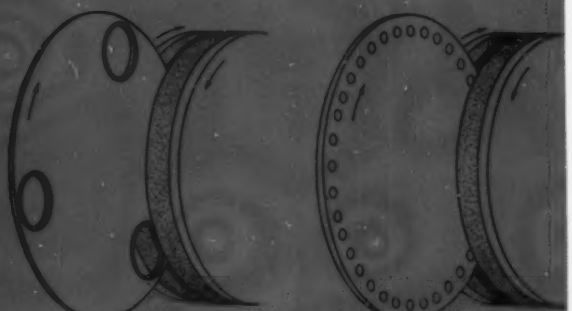
Technical Service Representatives in Principal Cities of U. S. and Canada

Export Division Cable Address: Oakite

For more information fill in page number on Inquiry Card, on page 179

Bearing manufacturer grinds large and small parts with new Gardner Disc Grinder

grinds TWO parallel surfaces in ONE operation



3 station rotary carrier with face cutting cycle

Continuously rotating carrier for small parts

2H30 Double Spindle Precision Disc Grinder

production data:	Races	Rollers
Size of workpiece	.504" Thick 6.508" O.D. 6.093" I.D.	1.25" long x 1.126" dia.
Production Rate: pieces per hour	100	600
Stock Removal: max. over-all	.010"-.012" per cut	.008"-.010"
Tolerances:		
Flatness and parallelism	.0002"	.0002"
Uniformity	.00015"	.001"
Squareness TIR	—	.0002"

. . . User reports continue to stress performance value of 2H30 . . . interchangeable work carriers permit quick change from job to job.

GARDNER

precision disc grinders

BELOIT, WISCONSIN

TRY THIS CAPER ON

Here's the way to *do it—do it faster—do it better.* Here's a lathe that will do things like no other machine in your shop.

The great big template is the tip-off. That—and the Air-Gage Tracer head there on the rear of the bottom slide—and the hydraulic unit. Put them together and you've got the speed and accuracy of the Air-Gage controlling straight in-and-out movement of the bottom slide and compound, with a push or pull to the cross-feed screw. With straight template angle-set as shown, this turns much steeper tapers than any regular taper turning attachment ever made. Stroke is 18"—giving a 36" diameter change at one setting. And you can handle any taper up to a 36" maximum diameter and a 45° angle.

Great? Sure—and there's more! You can chase

Big Work • Steep Taper • Overall Turning • Thread Chasing—Now Monarch Does it All Hydraulically!

Monarch

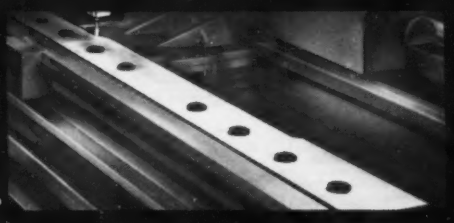
ACCURACY • ECONOMY • LONG LIFE

TURNING MACHINES

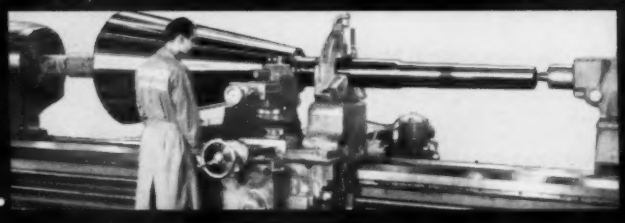
FOR A GOOD TURN FASTER . . . TURN TO MONARCH

YOUR TAPER

threads quickly (see photo of template set-up)—tapered ones, if you like. You can turn all shapes (up to a 45° angle) that you can on any Air-Gage Tracer controlled Monarch—and you can lock the cylinder in position and operate conventionally with all the advantages offered by Monarch Dyna-Shift design (a great big production-plus in itself). The Monarch Machine Tool Co., Sidney, Ohio.



b.



c.

a. **Template Set-up** for thread chasing. Straight template with 30° extension retracts tool hydraulically, eliminating need for neck and producing cheaper and stronger piece.

b. **End of Shaft** is turned with this template set-up. Machine can be operated conventionally or similarly to Air-Gage Tracer controlled lathes.

c. **Plug Assembly** turned on Monarch Model 4025-36 Series 90 Dyna-Shift Heavy Duty Lathe with hydraulic taper and forming attachment. It swings up to 48″ over bed, faces up to 42″ diameter change mechanically. It's versatile as they come!

2 to 3 times faster

Fixtures cost 20% less

Three of the 5 Burgmaster Turret Drills in operation producing hydraulic control valves for aircraft at Hydraulic Research and Manufacturing Company, Burbank, California.

1. VALVE BODY. Machined twice as fast on the Burg Turret Drill; Fixtures on some operations cost 20% less; Separate Tapping Machine Eliminated.

2. VALVE BODY. Machined 3 Times Faster on the Burg Turret Drill; Fixtures Simplified (drill bushings eliminated); Better Finish.

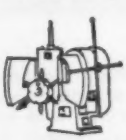
3. NICKEL IRON FRAME. Machined 20% Faster on the Burg Turret Drill; Reduced Tool Breakage to Minimum; Less Operator Fatigue.

4. HYDROMAT BODY. Two holes deep drilled 3.87" deep x 3/16" diameter, plus all other small diameter operations done on Burg Turret Drill; Separate Tapping Machine eliminated; Tool breakage eliminated and tool life greatly extended.

Specialists in High Production Turret Drilling

1C Manual Power Index 3/8" Capacity

2B Manual Power Index 3/4" Capacity



2BF Flange Mounted Power Index 3/4" Capacity

2BH Automatic Hydraulic 3/4" Capacity

3BH Automatic Hydraulic 1½" Capacity

2BR Ram Type Radial Drill 3/4" Capacity

2PT-3PT Automatic Tape Controlled 3/4" and 1½" Capacity

⅓ floor space

with

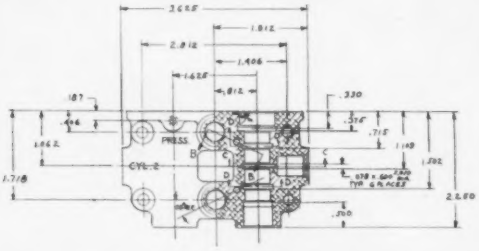
Burgmaster Six Spindle Turret Drill

(MODEL 2B ¾" CAPACITY)

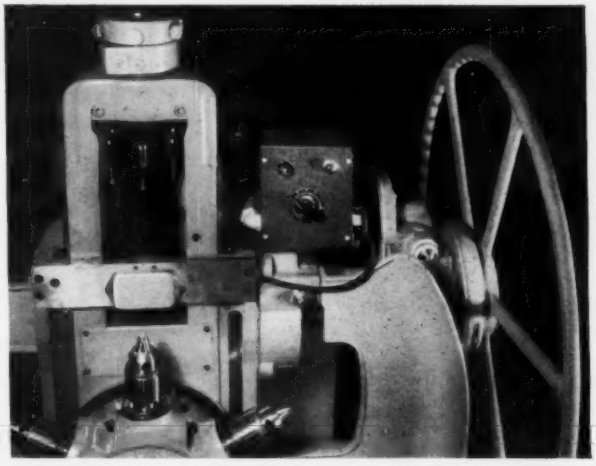
Hydraulic Research and Manufacturing Company, Burbank, California, receives all these benefits and more from the use of their five Burgmaster Turret Drills in manufacturing precision hydraulic control valves for aircraft. Parts like these require extra fine finish, and precision tolerances up to .0005" on some dimensions. Operations such as drilling, tapping, reaming, C' boring, C' sinking, chamfering, bottom drilling, and deep hole drilling are performed in various combinations at one work station. Formerly these parts were produced on single spindle table type machines which required more expensive fixtures for some operations, additional tapping machines, and required the operator to be constantly on the move, which reduced efficiency.

The Burgmaster 6-spindle turret drill with power indexing, quickly brings a series of tools into operation at one work station and cuts operator fatigue. Speed changes are pre-selected for most efficient cutting rates and are automatically changed for each spindle. The rigid construction of the machine, together with its precision manufacture including handscraped, dovetail ways, and counterweighted turret slide, assures the *sensitivity* required for small diameter tools. This reflects itself in less tool breakage, longer tool life, less spoilage, and finer finish, which are extra, cost reducing bonuses.

Burgmaster Turret Drills return their cost in a surprisingly short time—in many ways. It will pay you to compare the benefits of turret drilling with your present methods. There is a Burg direct representative or dealer near you who will be glad to assist —without obligation.



Sectional drawing showing multiplicity of operations performed on Burgmaster 6-Spindle Turret Drill. Five fixtures are used for the drilling operations, some of which, due to simplicity for operation on the Burgmaster as compared to single spindle machines, cost 20% less. All tapping operations are performed on the Burgmaster, eliminating the need for a separate tapping machine.



INFINITELY VARIABLE POWER FEED—is available for new or old Burgmaster Models 2A, 2B, 2BR (Radial) Turret Drills. The attachment permits a range of ½" to 7" per minute with power for drilling up to ¾" diameter in steel and provides a constant feed rate that assures fine finish, maintains tolerances, and reduces operator fatigue. Table switch is standard, foot switch is optional at extra cost.

Write for free bulletin describing Burgmaster 6-Spindle Model 2B Turret Drill with power indexing turret, pre-selective spindle speeds and pre-selective depth control, also 16MM sound film showing machines in operation, including the new automatic tape controlled machine available from any office.

BURG TOOL

MANUFACTURING COMPANY, INC.

15001 South Figueroa Street, Gardena, California
FAculty 1-3510 Dept. 1-M

BURGMASTER DIRECT SALES OFFICES:

Ridgewood, N.J.
86 North Maple Ave.
Gilbert 4-3002

Chicago 25, Ill.
5329 Lincoln Ave.
LOng Beach 1-1178

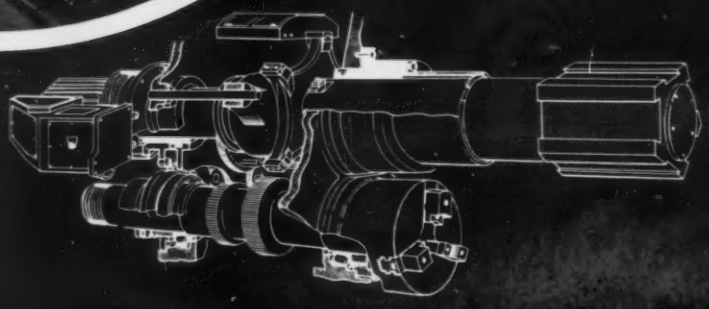
Cleveland 7, Ohio
14706 Detroit Ave.
ACademy 6-7030

Detroit 37, Mich.
13730 W. Eight Mile Rd.
LIncoln 8-4333

San Francisco, Calif.
1341 Old County Rd.
Belmont, Calif.
LYtle 1-0309

Plus dealer representatives in other industrial centers.

AT HUGHES AIRCRAFT COMPANY



Rigid 100% inspection on the machine! Before the part is removed from the Warner & Swasey "AC", the finish bore tolerance of .0002" is checked by the operator with an exacting Sheffield air gage shown above.

"On Target" Control of their Falcon Missiles begins on Warner & Swasey "ACs"

Hughes' Culver City, California, plant produces air-borne armament control systems for their famous Falcon air-to-air guided missile. Six Warner & Swasey Single Spindle Chucking Automatics are utilized interchangeably to produce many high precision turned components . . . consistently holding rigid missile tolerances, which, in some cases, mean .0002".

Production accuracy of Warner & Swasey Single Spindle Automatics is no accident. For example: only two wide—and widely spaced—bearing surfaces support the overhead pentagon turret, as shown on the opposite page, eliminating the cumulative tolerance problem of multiple bearing surfaces. Further, these support bearings are mounted in the same casting as the spindle, are completely enclosed, fully lubricated and subjected to exactly the same temperature. This assures holding precision tolerances constant all day, every day.

Hughes' air-borne armament control system displayed before two supersonic Convair F-102A all-weather interceptors. It directs the interceptor to the target (invading bomber) and releases the Falcon missile at precisely the most effective moment. The Falcons, with their own electronic system, then automatically "home" on the target and track it down for a fatal hit.

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

LOOKING FOR MORE FROM

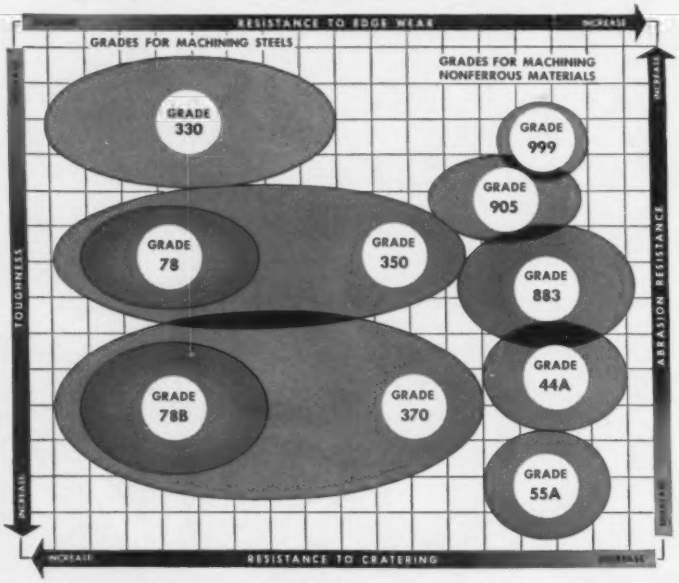
USE CARBOLOY® GRADE 78B General-Purpose carbide for top production—with low initial tool cost—on your steelcutting jobs

Long before anyone ever heard of "premium" carbides, Carboloy Grade 78B was doing a top-notch job as a high-quality, general-purpose steelcutting grade. It's *still* doing it—in thousands of plants where job requirements don't demand a carbide like Extra-Performance Grade 370.

On general-purpose steelcutting jobs, Grade 78B's lower initial cost pays off . . . and pays off handsomely. What's more, even on *tough* jobs, where runs are short, Grade 78B may prove itself the most economical carbide to use.

If you're not now using Grade 78B for general-purpose machining—or its companion, Grade 78 for finishing and light roughing—chances are you *should!* Order these two low-cost carbides from your Authorized Carboloy Distributor . . . today.

This complete team of Carboloy cemented carbides gives you more for your carbide tool dollar!



For more information fill in page number on Inquiry Card, on page 179

YOUR CARBIDE TOOL DOLLAR?

USE CARBOLOY® GRADE 370 Extra-Performance carbide on tough steelcutting jobs, for lower cost-per-piece, and long production runs

Carboloy Extra-Performance Grade 370 is the carbide to use where tool-cost-per-piece on heavy-duty jobs is eating up company profits. And it pays off, too, where production schedules demand longer-lasting tools to keep high-production machines in continuous profitable operation.

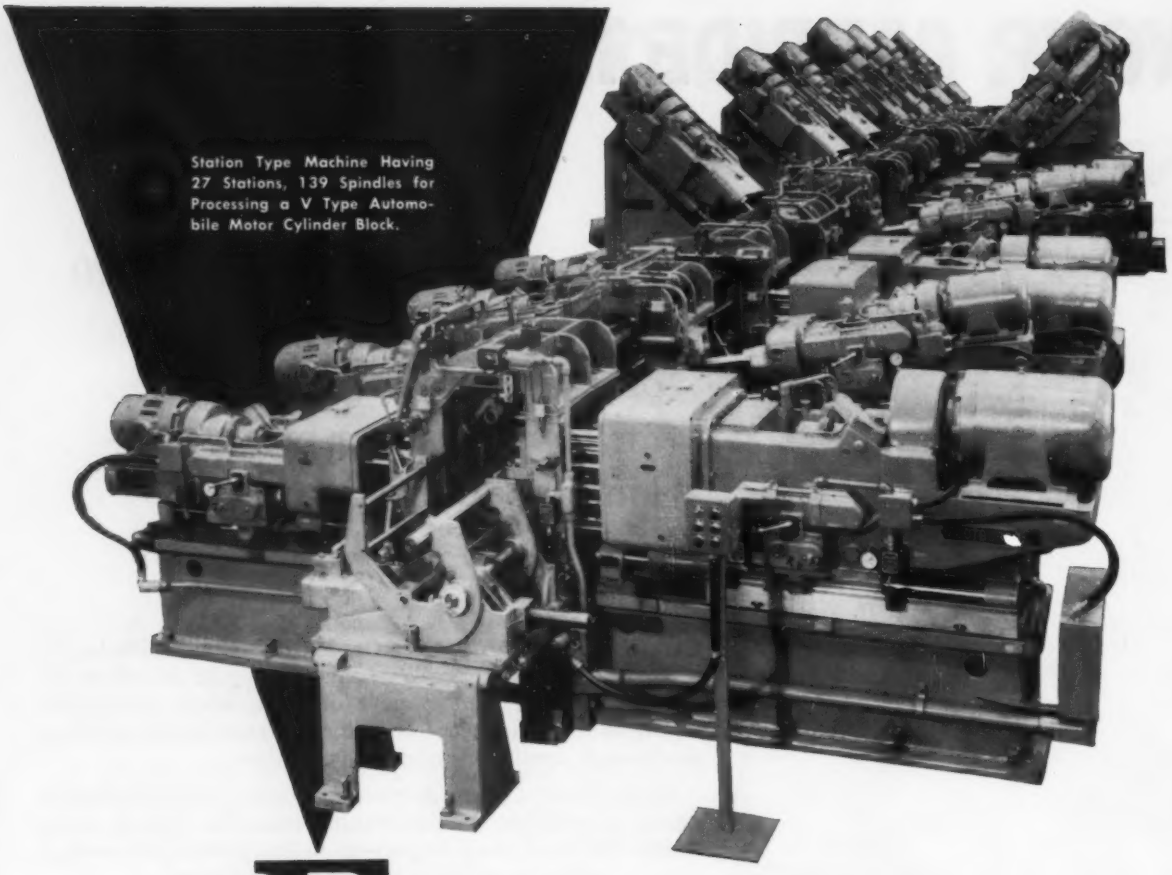
Grade 370 is the carbide everybody tries to match when it comes to roughing and interrupted cuts. But nobody does. Grade 370 stays sharp longer—at higher speeds and feeds—than any other heavy-duty carbide on the market.

Today, thousands of metalworking men are realizing significant production economies on heavy-duty jobs because Extra-Performance Grade 370 more than lives up to its name. Together with the other Carboloy Extra-Performance carbides—Finishing Grade 330 and Medium-Duty Grade 350—it can help you put a halt to declining profits. Just order from your local Authorized Carboloy Distributor. Then count the extra production you'll get . . . at lower cost-per-piece!

To get all the facts on Carboloy Extra-Performance Grades 330, 350, and 370—and General-Purpose Grades 78 and 78B—write: Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Ave., Detroit 32, Michigan.

CARBOLOY®
CEMENTED CARBIDES

GENERAL ELECTRIC



Station Type Machine Having 27 Stations, 139 Spindles for Processing a V Type Automobile Motor Cylinder Block.

FOOTBURT station type machines

PROGRESSIVE PRODUCTION . . .

With the Station Type Machine, Footburt continues to provide the most modern developments in production machinery.

Drilling, reaming, tapping, milling, checking and testing may be combined in one station type machine, and units may be mounted at any angle.

Installations of Footburt Station Type Machines have been made in many leading automotive plants, in some case handling the major machining on the block and head components.

ENGINEERED FOR PRODUCTION

THE FOOTE-BURT COMPANY, Cleveland 8, Ohio

Detroit Office: 24632 Northwestern Highway, Detroit 35, Mich.

FOOTBURT

MACHINE TOOLS

For more information fill in page number on Inquiry Card, on page 179

PRODUCTION POINTERS from GISHOLT

MASTERLINE GISHOLT SINCE 1887

ALLOY PRODUCTS MACHINES STAINLESS PARTS 25% FASTER

Uses JETracer and smart tooling to improve quality, increase output

Machining tough stainless steel? Having problems avoiding distortion, obtaining smooth finish and long tool life? Then this 4L Saddle Type Turret Lathe setup at Alloy Products Companies, Sanford, Maine, plant will interest you.

The workpiece, a rear bearing support, is handled in four operations alternated between opposing faces to minimize distortion. A JETracer or a bridge-type cross slide handles contour machining. A special cam on a cross-feeding hex turret taper attachment is used on the difficult bore. Longitudinal feed dials and precision dial indicators on the hex turret and cross slide speed longitudinal and cross positioning. For the third and fourth operations, fixtures are mounted on the chuck face instead of the spindle nose to reduce change-over time.

Here is a brief summary of the four-operation sequence:

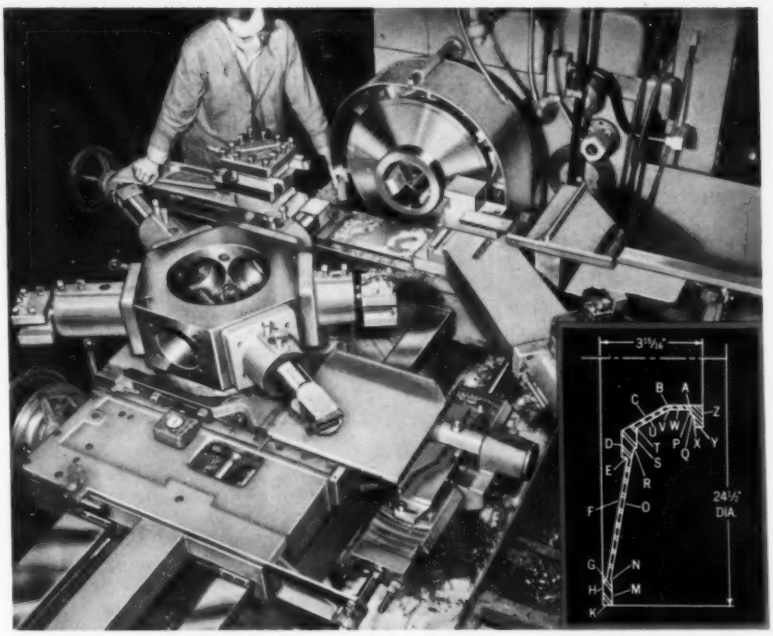
Operation 1—centralize and hold in bore A locating at H in 28″, three-jaw scroll chuck. Tool post tools rough surfaces M-S-W-K. Most of these cuts are made while hex turret tools are used to rough surfaces Y-Z-U. Contoured surfaces M-N-O-R-S-T-U-V are roughed by the JETracer. Time—60 minutes f.t.f.

Operation 2—using same chuck with new jaws, centralize and hold on diameter K locating at S. Tool post tools rough surfaces H-E. Again, these cuts are combined with hex turret tooling wherever possible, as surface D is rough-faced and A-B-C is rough-bored using the special cam guide plate on the cross-feeding turret taper attachment. The JETracer rough-faces H-G-F-E to complete the operation in 65 minutes, f.t.f.

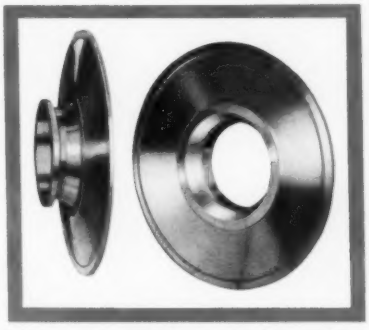
Operation 3—work is centralized and held at A using a hand-operated expanding mandrel and supporting rings at F-D. Tool post tools face Q-P, hand-feeding to depth at P, using the dial indicator. Surfaces M-N-O-R-S-T-U-V are finish-traced while Z is faced from the hex turret. W is turned, blending with V, and Y is turned from the hex turret. Tool post tools chamfer X and remove burrs from Y-Z to finish one side of the part in 35 minutes f.t.f.

Operation 4—work is centralized and held at Y, locating at S, using a hand-operated collet fixture with supporting rings at O-M. A-B-C is finished using the taper attachment. D is also finished from the hex turret. K is turned from the tool post and H-G-F-E is finish-traced. Time is 35 minutes, f.t.f.

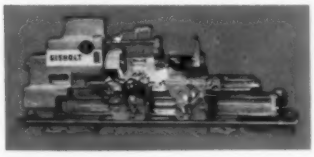
JETracer assures complete accuracy and smooth finish on all surfaces. Combined cuts and simple accessories speed machining, reduce operator fatigue. Alternating operations between work faces eliminate part distortion.



Work and tooling for first operation. Note dial indicator on cross-feeding hexagon turret for fast cross-wise positioning, and special cam guide plate on taper attachment for accurate machining of the bore.



Close-up of workpieces showing surfaces machined in the four operations. Note difficult contours and blends finished to blueprint tolerances using the JETracer and the special cam on the taper attachment.



THIS SETUP CUTS 1.5 MINUTES FROM 5-MINUTE JOB

Automatic cycle control speeds operation; octagon turret simplifies tooling

Here's how a well-known manufacturer cut machining time 30% on ⅞″-diameter steel tool holders. The machine, a No. 3 MASTERLINE Ram Type Turret Lathe, has a hydraulic drive unit to control octagon turret tools, provide automatic spindle speed and feed selection, automatic start-stop-reverse of the spindle and reverse feed, when required, to clean up a cut or clear turning or recessing tools.

The previously machined tapered shank of the ⅞″ holder mates with a centralizing ring and locates against a spring-loaded stop within a 10″, three-jaw air chuck. Tools on all eight turret stations are used to drill, turn, face, chamfer and machine three internal recesses.

Two different methods are used to generate the recesses. Slide tools on two stations are actuated by engagement of a roller with a positive stop on the overhead pilot. A third slide tool is controlled by a tapered cam mounted on a bracket across the bedways, near the spindle. In each case, continued longitudinal feed of the turret ram forces the tool-carrying slide to move vertically, engaging the tool for the recessing cut. Reverse feed is used to clean up the cuts and clear the tools. Time is only 3.5 minutes f.t.f.

A variety of holders, ranging from ¾″ to 1¾″ diameter, are handled with the same basic setup. Simple jaw inserts speed change-over. Rigid tooling easily holds runout within .0015″ for the length of the bore.

Smooth, positive hydraulic drive provides fine finish, maximum tool life, using proper speeds and feeds on all surfaces. Automatic cycle lets operator run another machine for extra savings.

Octagon turret tooling. Note slide tools, at right, operated by stop on overhead pilot. Also, tapered cam on bracket near spindle, used to actuate third slide tool.

⅞″ steel tool holders. Left to right: rough part; part showing O.D. machining; sectioned part showing internal machining.

HOW AMERICAN BLOWER ASSURES PRECISION BALANCING ON FAN ROTORS

Handles variety of rotors from 350 to 10,000 pounds, with one machine

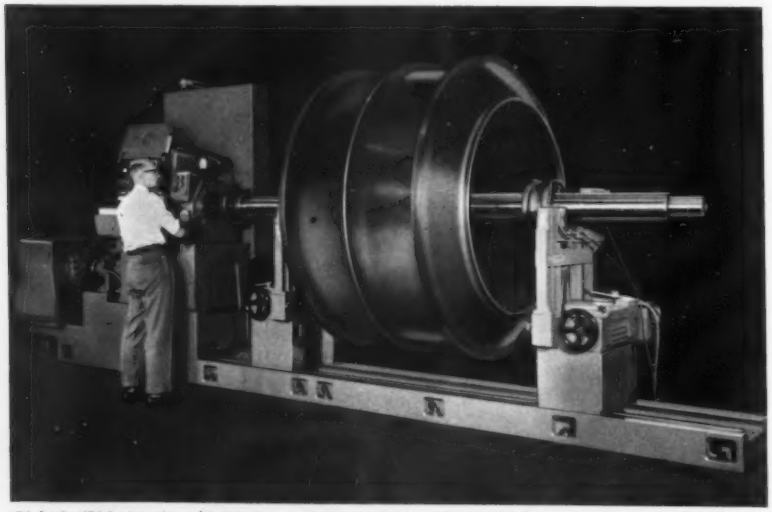
You'll be impressed with the job this 6U Balancer is doing for American Blower Division of American Radiator and Standard Sanitary Corporation at their Detroit, Michigan, plant.

To handle the large variety of parts, the 6U is arranged to handle workpieces up to 10,000 pounds, 98″ diameter, 120″ long and 14″ maximum bearing diameter. Because of the weights involved, the work-supporting bearings have independently controlled pressure lubrication. An American Blower adjustable speed Gyrol Fluid Drive, driven by a 30 h.p. motor, permits balancing rotors from 350 to 1500 pounds at 300 r.p.m., and from 1500 to 10,000 pounds at 150 r.p.m.

Work includes special high-speed wheels, double- and single-inlet wheels, compressor and fluid drive rotors. The balancer may be set up to locate and measure either or both single- and two-plane unbalance, depending on the part. The amount meter accurately measures bearing movements of .000025 at 300 r.p.m.

This setup on a double-inlet wheel is typical. The wheel and shaft weigh approximately 5600 pounds, and require only 30 seconds to accelerate to balancing speed and 30 seconds to stop. The operator measures and locates unbalance in each of the two correction planes in less than five minutes. Correction is made by welding at the indicated angles, leaving the part in the machine. To check for balance, the part is then rotated again.

Despite heavy workpieces and the large size of the machine, the 6U needs no special foundation for accurate operation. Electrical networks improve accuracy over former methods, and speed measurement and location of large amounts of unbalance.



Gisholt 6U balancing double-inlet wheel weighing about 3800 pounds with an 1800-pound shaft. Wheel is balanced within bearing movement of .0003 displacement or .0006 total bearing vibration at 150 r.p.m. Note American Blower Gyrol Fluid Drive at left end of machine.

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT

BOWER ROLLER BEARING CONES MACHINED 25% FASTER

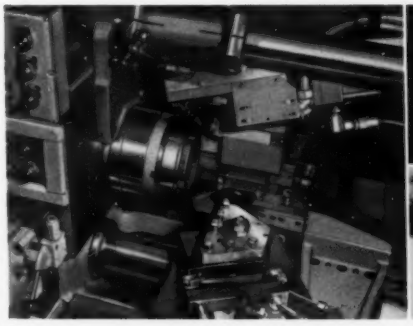
4-pass JETracer, auxiliary slide combine cuts, speed operation

Check this setup closely—it shows how Bower Roller Bearing Div. of Federal-Mogul-Bower Bearings, Inc., Detroit, Michigan, uses one basic set-up to cut time an average of 25% on more than ten different sizes of 4320 steel bearing cone forgings.

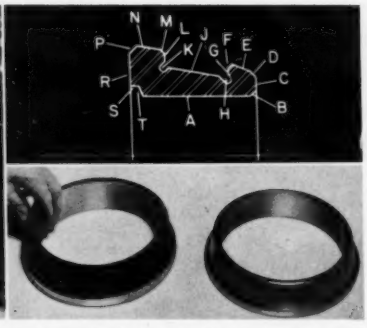
A standard MASTERLINE No. 12 Automatic Production Lathe is used. Special tooling includes a JETracer unit on the front slide having a four-position indexing template holder permitting one to four passes at the work during the automatic cycle. The tracing tools are held in a two-position tool holder that presents a roughing or a finishing tool to the work as required. Angular facing and grooving are handled from an overhead auxiliary slide, adjustable within a range of 15° to 90° from the spindle centerline to handle the wide range of parts.

Here's the machining sequence on an 8½"-diameter, 1⅞"-wide bearing cone. Surfaces A-T-S-R-P-N have been previously machined. An air-operated expanding mandrel holds in bore A locating at R. First, the JETracer roughs E-J-L. On the second pass, the same surfaces are semi-finished and rear independent slide tools face C and form relief H. The two-position tool holder indexes the finish tool to the work for the third pass and surfaces D-E-F-G-J-L-M are finished. Feed continues until a tool on an adjustable holder on the longitudinal feed bar forms B. The overhead auxiliary slide then forms K and finishes angular face L. Total f.t.f. time is just 2.70 minutes.

Two-speed motor provides proper surface speeds during turning and forming cuts. Four-pass JETracer permits multiple passes at the work for greater accuracy and longer tool life. Expensive form tools, previously used, are eliminated.



Workpiece on expanding mandrel, with circular recess tool on overhead slide ready to form recess K and shave angular face L. Note indexing tool holder carrying rough and finish tools.



Before and after workpieces showing stock removed (⅜" to ¼" on a side, more at flange and relief sections) and surfaces machined.

THE WM. POWELL CO. CUTS MACHINING COST 30%

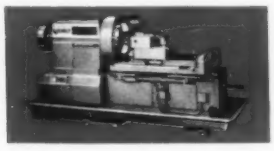
"Reverse" tooling lowers cost, ups production of plug valve bodies

Here's a special tooling setup that's paying big dividends in lower costs and increased production for The Wm. Powell Co., valve manufacturer in Cincinnati, Ohio. The machine, a Simplimatic, is equipped with a special valve body clamping fixture mounted on a screw-fed platen table, an air-operated loader mounted on the headstock, and a special cam-operated facing head mounted on the spindle.

Workpieces are placed on a spring-loaded tapered plug, on the loader A. The platen table is moved to the load position and pusher bar B forces the work onto the tapered plug, locating and centralizing in the bore. One side of the clamping carriage is fixed to locate the work on center and the other side grips for machining. The platen table retracts so the loader can move up, out of the way. Then, it moves forward to machining position and locks in place. Tools on the facing head move out from center to rough and finish the outer face, rough- and finish-face the co-bore and finish-size the co-bore diameter. The tools then return to starting position and the table retracts. The operator inserts a hook in the tapered bore and the clamping fixture releases for unloading. Floor-to-floor time on the 6" plug valve body shown is only four minutes.

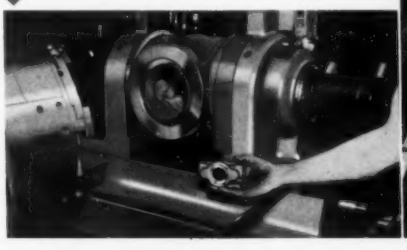
Twenty different plug valve bodies are handled in this manner. Sizes range from ¾" to 6" and average lots run 1000 pieces or less. Setup is fast because only the tools, the clamping carriage, the tapered plug and the machine stops need be changed or adjusted.

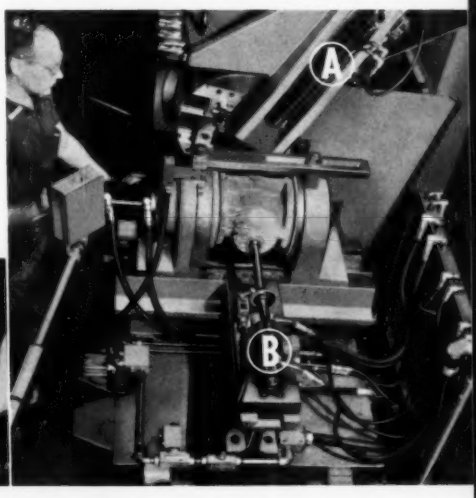
"Reverse" tooling eliminates expensive spindle-mounted fixtures, problems of fixture balance, and assures rigidity for accurate machining. Loader simplifies and speeds work handling.



Loader A supports workpiece as pusher rod B locates and centralizes on tapered plug for clamping in fixture. Note extended push-button control panel permitting operator to observe and control operation from one position.

Largest and smallest plug valve bodies are handled with this setup.





MASTERLINE GISHOLT SINCE 1887

HOW HARNISCHFEGER SAVES 5 MINUTES ON CLUTCH PART

2-speed motor, rigid cross-slide tooling simplify forming operation

This job-story is especially for those producing parts requiring heavy forming or grooving operations in addition to standard turning, facing and boring.

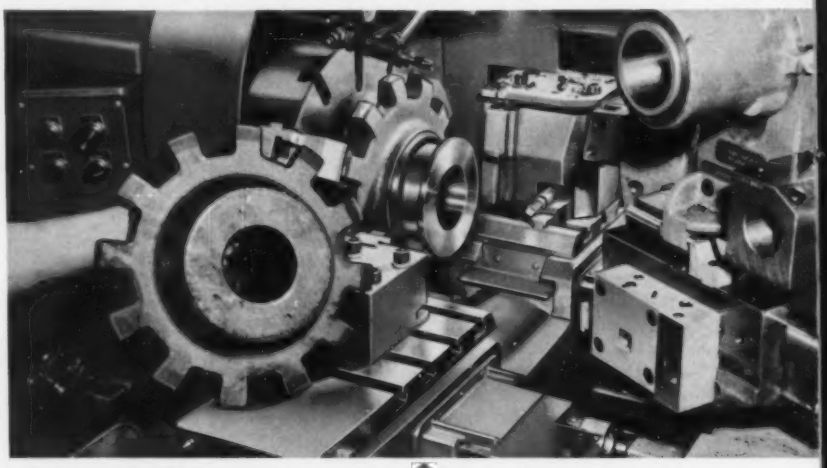
The part is a tough steel male-clutch forging, hardened to 255-285 Brinell. It's machined in two operations on a MASTERLINE 2F Fastermatic Automatic Turret Lathe at Harnischfeger Corporation's Milwaukee plant.

For the first operation, an 18", three-jaw air chuck holds at X, locates at Y. The hex turret is set at non-index. Forward longitudinal feed turns A. Then the turret holds in place as a turret-facing attachment on the rear cross slide operates a turret-mounted slide tool, facing C-B. F.t.f. time: 2.8 minutes.

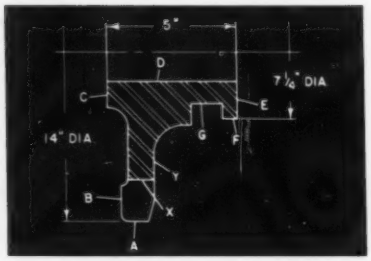
For the second operation the same chuck is used, and the work is held on A, located against B. Hex turret tools turn F, face E and rough- and finish-bore D. Front cross-slide tooling roughs and rear cross-slide tooling finishes the deep groove G, using the low side of the two-speed motor to assure maximum tool life and a fine finish. F.t.f. time: just 8.5 minutes.

The same machine handles a variety of parts, including several sizes of sheaves, rollers and jaw clutches.

Fastermatic's smooth, hydraulic feed against positive stops assures repeat-accuracy, better finish on all cuts. Time is saved by intelligent use of simple accessories, including two-speed motor, turret-facing attachment and turret-facing slide tool. These also provide added flexibility to handle other parts at no additional cost.



Close-up of work and tooling for second operation. Note: tool block on rear cross slide with massive dovetail form tool used to finish form groove G, and stock removed when compared to rough workpiece in foreground.



GRINDING ELIMINATED WITH THIS SETUP

Manufacturer saves time, cuts costs by Superfinishing from machined surface

Model 81 Superfinisher tooled to Superfinish machined thrust face to eliminate intermediate operations. Chamfering attachment permits completing two operations in one quick 30-second cycle.

Looking for smoother, flatter, longer wearing thrust or seal surfaces? Want to cut costs by eliminating unnecessary intermediate operations? Then you'll want to study this setup at a well-known automatic transmission manufacturer's plant.

The machine is a Gisholt Model 81 Single-Spindle, High-Production Superfinisher. The workpiece is a cast iron automatic transmission front clutch cylinder of 163-207 Brinell hardness. Here's how the parts are handled in one fast operation.

The work is placed in a fixture mounted on the lower, work-rotating spindle. The operator presses the cycle-start button and the upper rotating quill descends, engaging a cup-type stone with the thrust face. The work-holding spindle and the stone-carrying spindle rotate in opposite directions. In just a few seconds stone contact time, the machined surface is reduced to 20 micro-inches RMS. At the same time, a chamfering attachment mounted on the side panel deburrs the splined O.D. edge. Time: only 30 seconds f.t.f.

Superfinishing machined surface saves intermediate operations, provides desired low micro-inch surface finish, exposes true base metal for long service life. This setup permits production of 95 parts per hour at 80% efficiency.

No. 5-658
707

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

Printed in U.S.A.

GISHOLT MACHINE COMPANY Madison 10, Wisconsin

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

Interstate Drop Forge Company—

20 Years a Cities Service Customer and Still Forging Ahead!

The modern way to cut a die is typified by die sinking machine, one of many at Interstate Drop Forge Company. All die sinking machines are lubricated by Cities Service lubricants.

With production running at roughly 1000 tons per month, Interstate Drop Forge Company of Milwaukee is one of the largest forging concerns in the Wisconsin area and growing all the time.

An integral part of this growth story, Cities Service is proud to have filled Interstate's lubrication needs for the past 20 years.

Drop hammers . . . helve hammers . . . upsetters . . . forging rolls . . . shapers . . . automatic metal saws. These are but a few of the diversified machines lubricated by specially tailored Cities Service oils and greases.

Actually, in a plant of this type with so many differing pieces of machinery, it would be possible to have as many as 25 different lubricants. But, Interstate, with the aid of their Cities Service Lubrication Engineer has been able to standardize on twelve Cities Service lubricants.

Streamlining . . . standardizing . . . improving. These are some of the services a Cities Service Lubrication Engineer can render for your operation, too. Ask him to make a free lubrication survey of your plant. Call the nearest Cities Service office or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

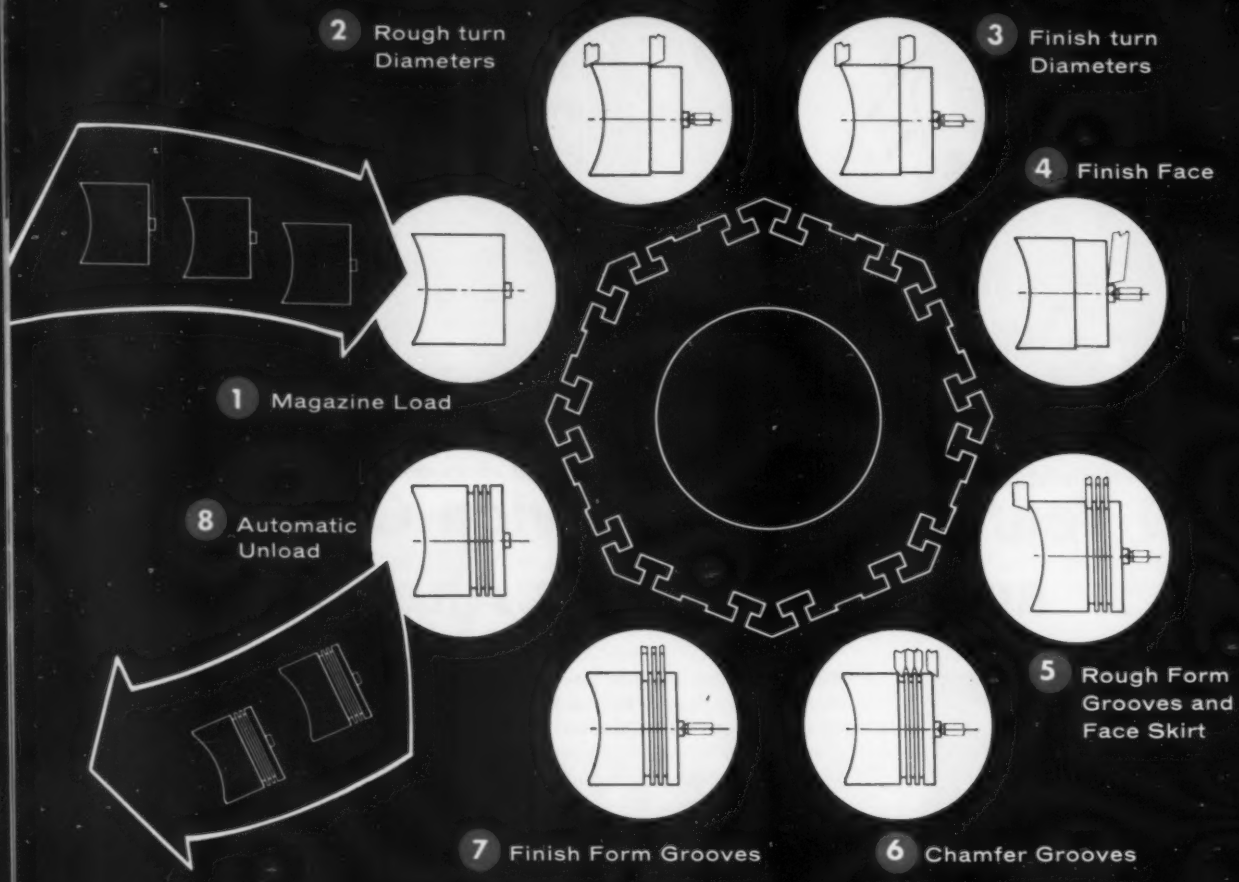
QUALITY PETROLEUM PRODUCTS

For more information fill in page number on Inquiry Card, on page 179

here is

circumferential automation

at work . . .



Here's an example of Circumferential Automation integrated into an automated production line. Castings are conveyed to the magazine which loads the machine. After machining (16 operations in 8 seconds) is completed the piston is automatically unloaded—carried on to assembly.

...Automatic Load—Unload Accessories INTEGRATE

circumferential automation*

and in-line automation

* Each spindle of an Acme-Gridley Automatic is a work station where a number of machining operations can be performed. From the time the work piece is loaded into the spindle it is never let go; indexes from station to station where pre-sequenced operations are carried on without manual attention. Upon completion workpiece is released at the unloading position and is subsequently transferred to the line. Secondary operations are eliminated. This is automation . . . circumferential automation.

Acme-Gridley automatics equipped with magazine loading and unloading devices can easily be integrated into fully automated production and assembly lines. They provide maximum production flexibility and assure day-in, day-out operation with minimum human attention.

Let us show you how circumferential automation can go to work for you.—our representative will be glad to call without obligation.

National Acme

THE NATIONAL ACME COMPANY, 179 E. 131ST ST., CLEVELAND 8, OHIO • Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

All 'round the world where there's work to be done
and time to be saved there's an Acme-Gridley to do it.

NEW! Carlton 3AR rigid

Now you can enjoy the advantage of automation as applied to heavy duty production hole drilling and boring . . . with the new Carlton 3AR, the first double box column vertical drilling machine produced for use with automatic positioning (or spacing) tables.

The new Carlton **3AR** introduces jigless heavy duty drilling and boring on a production basis.

With the Carlton 3AR and any one of the many fine types of tape or hydraulic controlled positioning tables on the market today, you can now

- Increase hole drilling production *automatically.* Work is positioned under the drill automatically, and therefore, *faster.* No delays from human inertia.
- Get precision drilling, boring and spacing. Automatic positioning tables assure precise hole spacing; rigidity of Carlton's double box column construction assures hole drilling precision. No mistakes, ever.

In short, the new Carlton 3AR is made just for you and every manufacturer who needs precision, heavy duty, flexible production drilling and boring. Wire or phone us today for price and delivery estimates.
The Carlton Machine Tool Co., Cincinnati 25, Ohio

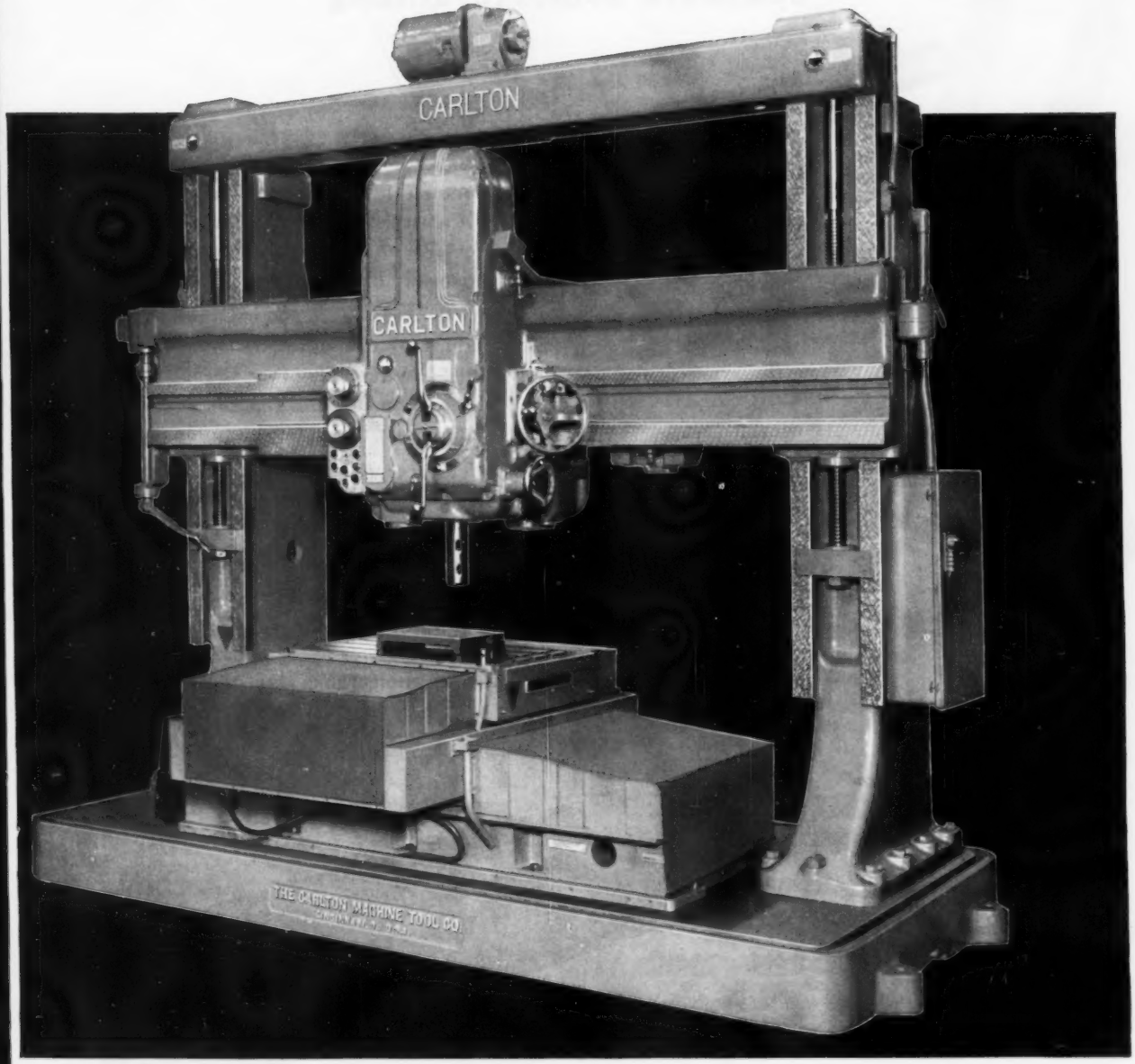
- Twin screw elevating for the rail.
- Headstock movable to facilitate loading and unloading of positioning table.
- Choice of pre-select or manual shift spindle speed control.
- Hand feed wheel equipped with micrometer adjustment dial for precision depth boring.
- As simple and easy to operate as a Carlton radial drill.

specifications

Vertical travel—rail on box posts	27"
Vertical travel—spindle in head	18"
Distance, floor to spindle (min.)	30"
Distance, floor to spindle (max.)	75"
Horizontal travel of head on rail	28"
Spindle speeds, number	36
Spindle speeds, range rpm	100 to 1
Feeds, number	18
Feeds, range	.004"-.125"
Motor, recommended, hp.	25-30

for the most modern in hole drilling machine tools . . . see

vertical drilling machine



Carlton *specialists in drilling*

THE CARLTON MACHINE TOOL CO., CINCINNATI 25, OHIO, U.S.A.

For more information fill in page number on Inquiry Card, on page 179

NEW CLEVELAND SPLIT SLEEVES . .

Greater concentricity between hole and body of this high quality sleeve assures longer tool life and more accurate drilling

LIST NO. 201
(A.S.A. Taper Shank No. 1)
For Fractional Size Drills 1/16" to 3/8"
Wire Gauge No. 1 to No. 52
Letter Sizes A to U.

LIST NO. 202
(A.S.A. Taper Shank No. 2)
For Fractional Size Drills 1/16" to 9/16"
Letter Sizes A to Z

LIST NO. 203
(A.S.A. Taper Shank No. 3)
For Fractional Size Drills 25/64" to 3/4".

LIST NO. 204
(A.S.A. Taper Shank No. 4)
For Fractional Size Drills 3/4" to 1".

These new and improved Split Sleeves for straight shank tanged drills are made with precision holes, accurately air gaged for size and roundness to maintain extreme accuracy.

Modern manufacturing methods assure a high degree of concentricity between the hole and the body of the sleeve. There is less run-out at the drill point, resulting in longer tool life and better holes.

They are properly heat treated to resist distortion, mutilation and wear, and at the same time to provide the proper spring action for easy drill release and removal.

CLEVELAND Split Sleeves are designed and produced to the same high standards which have made the familiar ◈ trademark famous for quality since 1876.

Telephone Your Industrial Supply Distributor

Now your CLEVELAND Distributor can give you good service on CLEVELAND Split Sleeves. Be sure to order CLEVELAND Split Sleeves the next time you buy tanged straight shank drills!

CUT YOUR DRILLING COSTS 2 WAYS!

CLEVELAND Split Sleeves, used with these Tanged Straight Shank CLE-FORGE Drills, give you greater economy

CLE-FORGE High Speed Drills have long been recognized for giving *more holes per grind.* Now, with the new CLEVELAND Split Sleeve, you can more effectively use tanged straight shank CLE-FORGE Drills *and get more flute length at lower cost.*

Instead of paying for a taper shank on every drill, you get the needed length with a split sleeve—which outlasts many drills.

On many jobs requiring extra length drills, the combination of CLEVELAND Split Sleeves and CLE-FORGE Taper Length Drills eliminates the need for special tools.

LIST NO. 915
Fraction Sizes
1/4" to 1/2"
Wire Gauge Sizes
No. 1 to No. 52
Letter Sizes A to Z

LIST NO. 916
Fraction Sizes
33/64" to 1 1/16"

LIST NO. 949
Fraction Sizes
1/8" to 1 1/16"

LIST NO. 950-K
Heavy Duty Drill
Fraction Sizes
1/8" to 1 1/4"

Below are shown seven types of Special Purpose Straight Shank CLE-FORGE High Speed Drills. These drills are not regularly available with taper shanks, but they can be furnished with tangs (at no extra cost) and used with CLEVELAND Split Sleeves.

Taper Length Regular Milling

Drills for Plastics

Taper Length Heavy Duty Hy-Spiral

Hy-Spiral or High Helix Drills

Low Helix or Drills for Brass

Heavy Duty or Cotter Pin Drills

Jobbers Length Cobalt Drills

THE CLEVELAND TWIST DRILL CO.
1242 East 49th Street • Cleveland 14, Ohio

Stockrooms: New York 7 • Detroit 2 • Chicago 6 • Dallas 2 • San Francisco 5 • Los Angeles 58

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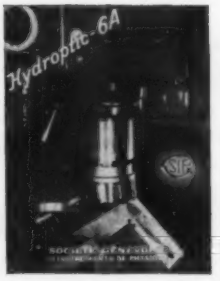
. . . attained with the New SIP HYDROPTIC 6A Jig Boring and Milling Machine

Due to unprecedented cutting ability . . . increased range and capacity . . . simplification of controls . . . and ease of operation, the HYDROPTIC 6A is unmatched in performance.

Up to **30% increase** in productivity has been realized with the AUTOMATIC COORDINATE REPEATING DEVICE DIR (optional equipment) which repeats successively the initial settings made during the machining of the first workpiece.



For complete information, send for Catalog No. 1149.

As with all SIP HYDROPTICS, *accuracy is based on* SIP *High Precision* STANDARD SCALES.

AMERICAN SIP CORPORATION • 100 EAST 42 STREET, NEW YORK 17, N.Y.

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Tool Steel Topics

BETHLEHEM STEEL

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Highway Guard Rail Brackets Formed Red-Hot with Cromo-W

The product is a steel offset bracket, ¼ in. thick. It's used for fastening wire rope to highway guard rail posts. The bracket is formed red-hot, with a two-stage die of Bethlehem Cromo-W tool steel. Between 90,000 and 100,000 pieces are produced before redressing becomes necessary.

Cromo-W has a 5 pct chromium content and is one of our most popular general-purpose tool steels for a variety of hot-work applications. It offers good red-hardness and high shock-resistance. It also has good resistance to heat checking when cooled drastically during high-temperature operations, and is easy to machine and heat-treat.

Cromo-W is an ideal grade of tool steel for such diversified uses as die casting dies, bolt-gripper and bolt-header dies, trimmer dies, punches, and hot shear blades. In fact, it's a grade you can count on for long service in virtually any manufacturing operation involving severe shock and temperature change.

Typical Analysis

Carbon 0.35	Tungsten 1.55
Silicon 1.05	Molybdenum 1.65
Chromium 5.15	

In addition to Cromo-W, Bethlehem offers Cromo-WV and Cromo-High V for die casting and extrusion work. See your Bethlehem tool steel distributor for full details on these fine hot-work grades.

General view of the forming operation. Cromo-W is ideal for this hot-work application because of its good red-hardness and high shock-resistance.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Machining is a Tearing Operation

Close examination of the surface of a machined part, or chips machined from it, indicates the presence of countless minute tears. Generally, the tears can be seen most readily on parts machined at low speeds, with heavy feed and depth of cut. However, they are also present in all machined surfaces, even though not readily visible. The depth of surface tears on smooth machined tools and dies may be approximately one thousandth of an inch, or less. For this reason, the presence of the tears and their possible effects are often overlooked.

Most tools are heat treated after machining. Then they are ground all over to produce the exact dimensions, and to remove scale or decarburization resulting from the hardening operation. This procedure automatically removes tears in the surface previously produced during machining. However, many tools are ground only on certain portions, with the balance of the tool surfaces containing the remains of the machining tears, plus heat treatment scale and decarburization. This condition occurs often when you grind only the actual working surfaces which make contact with the parts. Tools produced by this method are more susceptible to failure in service because of stress concentration produced by the sharp change of section in the tears. This is particularly true of tools subjected to a large number of stress cycles in service, such as pneumatic tools.

Grinding all previously machined surfaces of tools after hardening is an operation which helps improve production from the tools. Grinding before hardening will also be effective, should grinding after hardening be inconvenient.

all these parts . . .

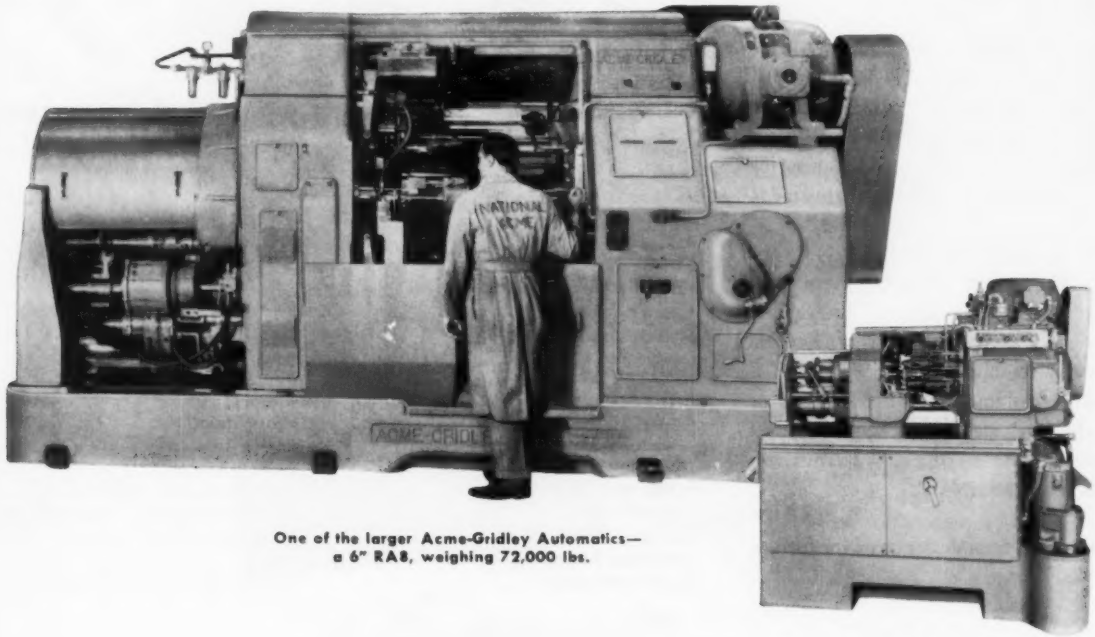
Produced on *Acme-Gridley* Automatics without secondary operations

The parts illustrated show only a small sampling of the range of capacities.

No line of automatic production equipment in the world equals Acme-Gridley in capacity range. These Automatics produce parts so small they can be examined only under a magnifying glass, or parts weighing a hundred pounds. Most parts machined on Acme-Gridleys require no secondary operations, this means no costly extra handling.

Acme-Gridley's outstanding performance results from a combination of design features including rigid box-type construction, ample "beef" properly distributed, and a wide open tooling zone. The tooling zone lends itself to a broad range of tooling installations limited only by the tool engineer's ingenuity.

Find out how you can put Acme-Gridley Automatics to work for you turning out parts at lower cost and highest accuracy—our representative will be glad to call without obligation.



One of the larger Acme-Gridley Automatics—
a 6" RA8, weighing 72,000 lbs.

Newest Acme-Gridley, the 7/16" RA6,
weighs only 5,200 lbs.

National Acme

THE NATIONAL ACME COMPANY, 179 E. 131st St., CLEVELAND 8, OHIO • Sales Offices: Newark 2, N. J., Chicago 6, Ill. Detroit 27, Mich.

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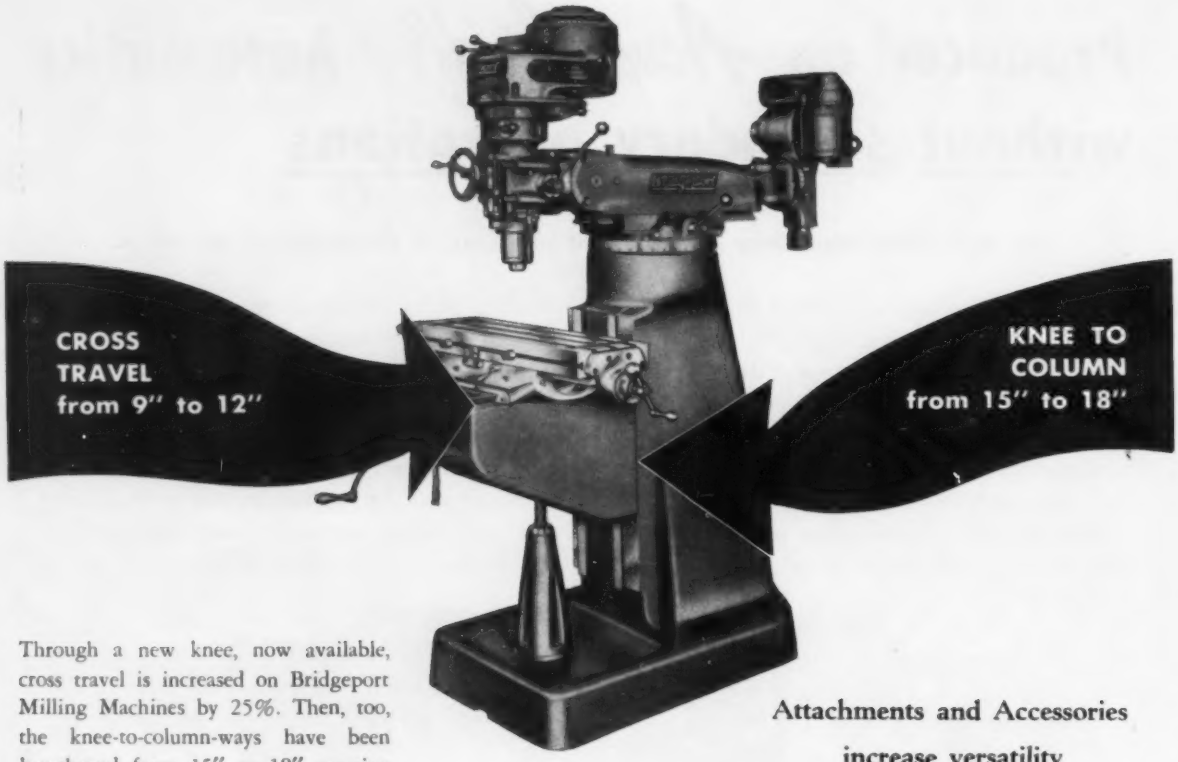
Bridgeport INCREASES *CAPACITY* . . .



Through a new knee, now available, cross travel is increased on Bridgeport Milling Machines by 25%. Then, too, the knee-to-column-ways have been lengthened from 15" to 18" assuring the maximum in rigidity and alignment.

Where more productivity is needed through greater capacity, these new features available in the "Bridgeport" at only a slight extra cost, will appeal strongly to shopmen everywhere. Toolmakers, moldmakers, pattern makers or production machinists will be well pleased with the greater productivity now made possible.

Ask your nearest dealer or us for further details.

Attachments and Accessories increase versatility

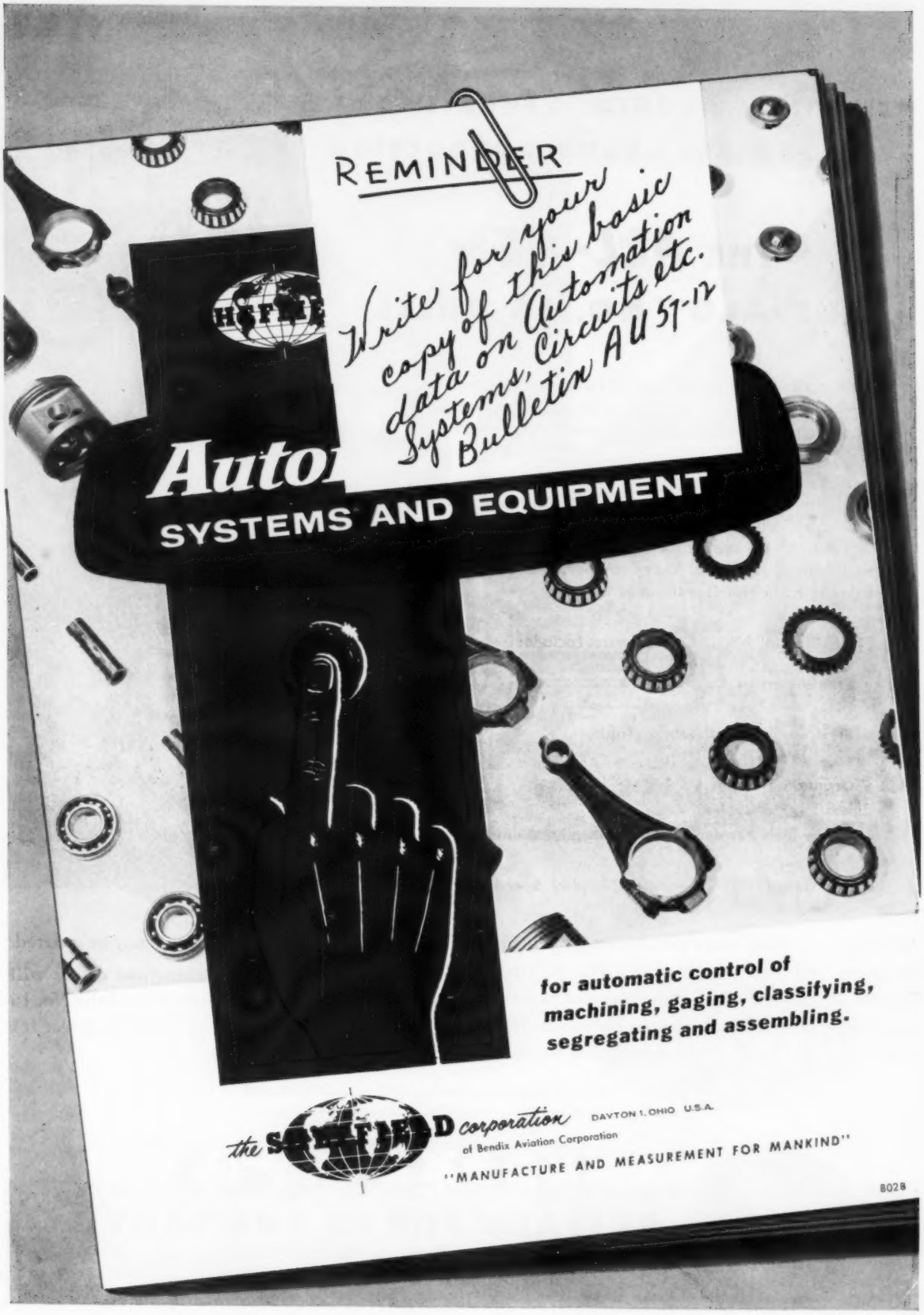
Milling, Drilling and Boring Attachments: Model "J" 1 HP; Model "M" ½ HP; Model "R" ½ HP and Model "C" ¼ HP (Rigid Spindle)

- Cherrying Attachment
- Slotting Attachment
- Power Feed
- Measuring Attachment (Rods and Indicators)
- Optical Measuring System (A recent addition to the Bridgeport line)
- Hydraulic Duplicators (Single Dimension and Three Dimension)
- Coolant Pump
- Four-Inch Raising Block
- Seven-Inch Raising Block
- Cross Travel Stops
- Lights
- Right Angle Attachments Nos. 1,2,3.
- Shell Mill Holders Nos. 1,2,3.
- Fly Cutters, FC-3, FC-4
- Threaded Arbors
- Stub Arbors
- End Mill Holders
- Spindle Adapters
- Vises No. 1 and 2 (Swivel and Plain)
- Profilers for Model "J" and "M" Heads
- Boring Heads Nos. 1 and 2.
- Collets
- Chucks (Jacobs and Albrecht)

Bridgeport MACHINES, INC.

Bridgeport, Connecticut

Manufacturers of High Speed Milling Attachments and Turret Milling Machines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Write for your copy of this basic data on Automation Systems, Circuits etc. Bulletin AU 57-12
SYSTEMS AND EQUIPMENT
for automatic control of machining, gaging, classifying, segregating and assembling.
the SHEFFIELD corporation
DAYTON 1, OHIO U.S.A.
of Bendix Aviation Corporation
"MANUFACTURE AND MEASUREMENT FOR MANKIND"
8028

SENSITIVE, RUGGED, VERSATILE—
TOPS FOR ALL-ROUND PRODUCTION

THE *ALL-NEW*
"BUFFALO" NO. 15 DRILL

The totally-new "Buffalo" No. 15 Drill combines brand new "easy-to-operate" features with the time-proven advantages earned by industry's choice for over twenty-five years.

The No. 15 has always been famous for its extreme sensitivity, which ideally suits it for small hole drilling. At the same time this versatile drill is sufficiently rigid and heavy to operate at full capacity without undue strain or wear.

New "Buffalo" No. 15 Drill Features Include:

- **Front-Mounted Start-Stop Switch.**
- **Easily-Read Speed Range Table.**
- **Graduated Depth Gauge.**
- **Proper Belt Tension is Automatically Maintained.**
- **Belt Guard Tilts Upward to Simplify Speed Changes.**

All these and many more notable improvements are yours with the new "Buffalo" No. 15 Drill. The No. 15 line includes bench, floor and pedestal models. Bench and pedestal types are available in 1- to 6-spindle models. Attachments for tapping, mortising, routing or spot-facing may be ordered.

Your nearby "Buffalo" machine tool dealer will be glad to arrange a demonstration of the No. 15 Drill. Contact him today, or write us direct for Bulletin No. 4024.

"Buffalo" products bring you the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

ESTABLISHED 1877 "Buffalo" MEMBER N.M.T.B.A.

BUFFALO FORGE COMPANY

440 Broadway • Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRILLING PUNCHING SHEARING BENDING

You asked for it . . .

AND HERE IT IS . . .

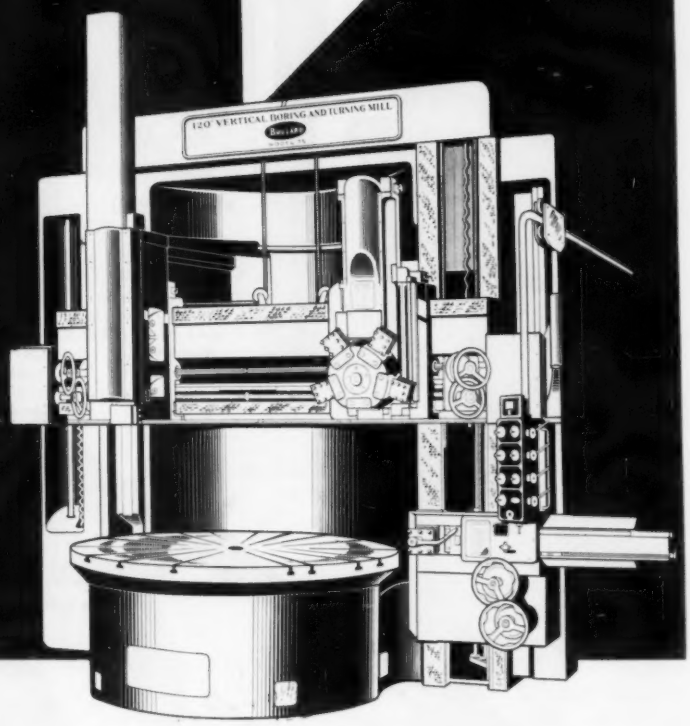
THE NEW

BULLARD 120"

VERTICAL BORING AND TURNING MILL

SWINGS 120" — TABLE SIZE 108"

Recognized for over seventy-five years as the leading builder of vertical turret lathes and boring mills, The Bullard Company has been repeatedly asked to build mills of a larger size incorporating the features of the Model 75 line.



The Bullard 120 Vertical Boring and Turning Mill is designed, engineered and built to meet this customer demand. Feature for feature — by comparison — you'll find it is the outstanding mill on the market today.

BULLARD

REMEMBER . . . to cut costs when cutting metal — Buy BULLARD

Check all the advantages — get the full story by calling your nearest Bullard Sales Office or Distributor.

THE BULLARD COMPANY
BRIDGEPORT 2, CONNECTICUT

For more information fill in page number on Inquiry Card, on page 179

PRECISION REQUIRES SPECIAL

and Gets it with FEDERAL

If you are not kidding yourself about Precision you know you have to gage a dimension a certain way if you want an accurate measurement.

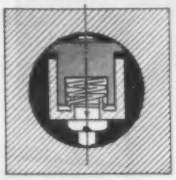
That's why good gage users know that just *any* gage is *not* good enough. And that is why Federal makes so many different types of gages of the same general kind.

There are all degrees of accuracy required and

Whatever You Need in Gages

Ask **FEDERAL** *First*

OVER 12 TYPES of HOLE GAGES in all sizes



Model 1250 Series
Positive Centralization
Set directly to Gage Blocks or Micrometers
4 sizes cover all diameters

Model 149P
I.D. Caliper Gage
(also Model 49 O.D. available) Stock and Special Models of All Shapes

Many Other Types.

Send for Catalog.
Illustrates the most extensive line available.

Model 1201 Series

Model 1203
.122"-.250" Diameters
Model 1204
.250"-.506" Diameters

Model 1242 Series
(Two-contact)
Model 1243 Series
(Three-contact)

Model 165 Series
Single Purpose Plug Type

Model 88 Series
Shallow Hole, Bore or Shoulder I.D. O.D. Diam. Adjustable and Single Dimension Models

Model 36 Series
Bench Type Hole and Outside Diameter Gages

Gages Can Be Modified Specially to Suit

TREATMENT

DIAL GAGES

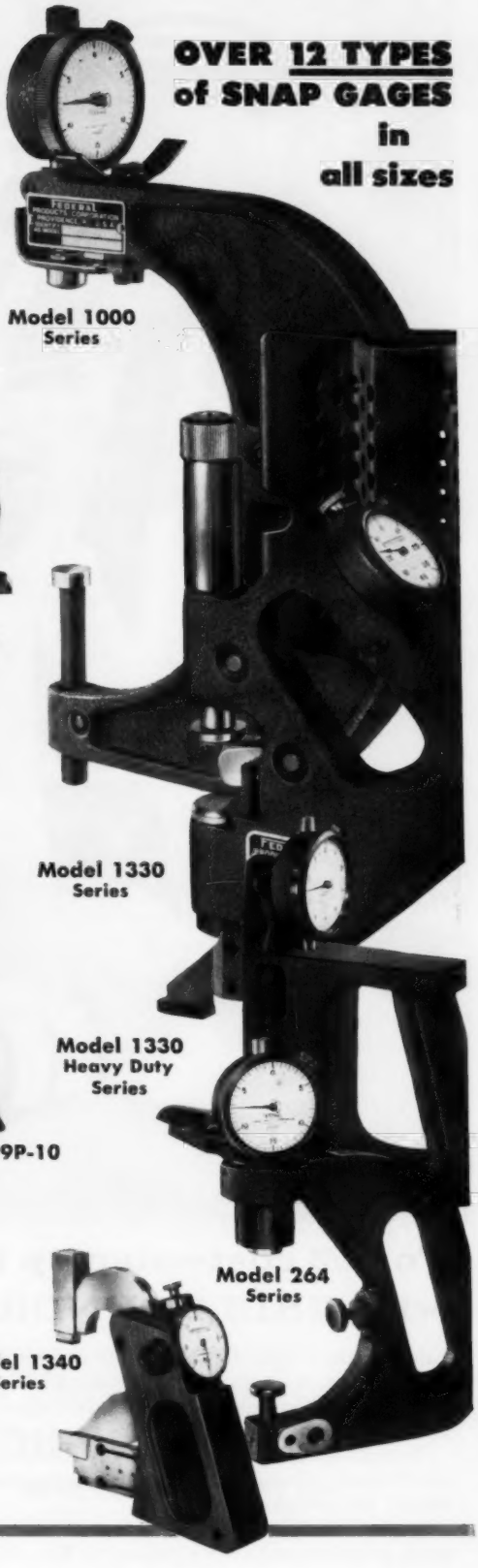
Federal takes the care to obtain that accuracy.

And some need more gaging pressure, and some less, and some need narrow anvils and some need wide anvils. Some want to gage just a hole diameter and some want to know if it's round or if it tapers.

It's easy to find the gage you need to check a dimension the right way — get in touch with us. Do it now.

Federal Products Corporation
8116 Eddy Street **Providence 1, R. I.**

OVER 12 TYPES of SNAP GAGES in all sizes



Model 1000 Series

Model 75 Series

Model 65 Series

Model 1330 Series

Model 1330 Heavy Duty Series

Model 264 Series

Model 1340 Series

DEPTH GAGES

All types — knife edge, long range, special anvils and special types.

Model 75P-10 Adjustable

GROOVE GAGES

I.D.
O.D.
Depth
Concentric
Width

Model 99P-10

Model 99P-11

Model 99P-12

For 1/3 cost—step up to new-hammer performance with ERIE FOUNDRY REBUILDING SERVICE

Erie Foundry Rebuilding Service will disassemble and inspect your hammer, re-machine worn surfaces, true bearings, replace broken parts. Then we re-assemble and test your hammer before returning it. It will operate like a new machine.

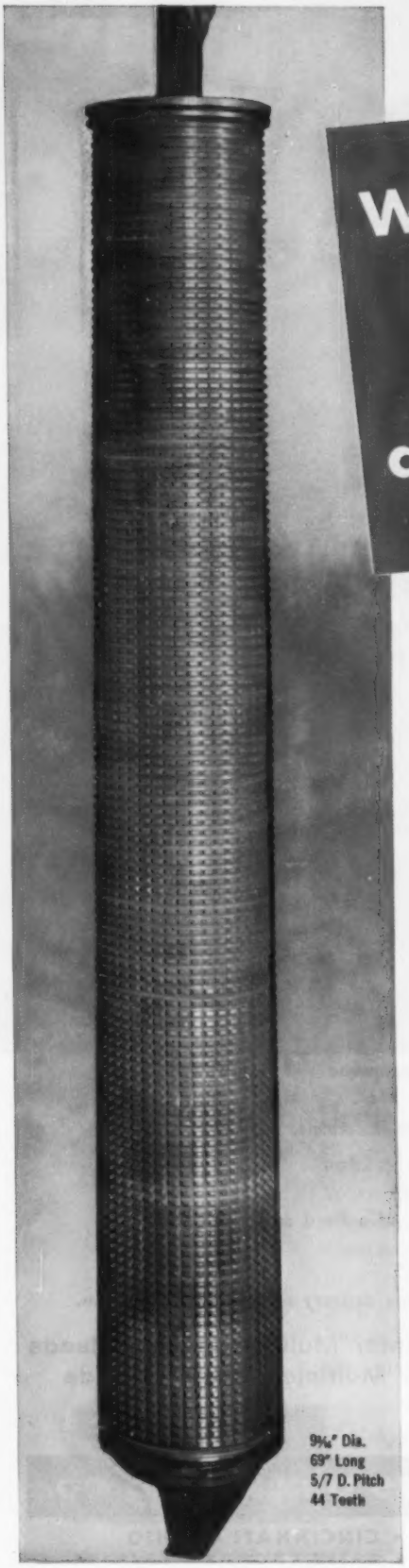
You can trust Erie Foundry Factory Rebuilding Service . . . over 60 years of leadership in building forging hammers stands behind our revitalizing work.

Regardless of make, and regardless of condition, send your tired, worn forging hammer "home" to Erie. Please write

ERIE

Greatest name in forging hammers since 1895

ERIE FOUNDRY CO., ERIE 5, PA.



Who Would You Trust to HEAT-TREAT a BROACH Like This?

At the time this Red Ring Naloy Broach* reached heat-treat, about $5,000.00 had been spent on it. One mistake during the heat-treat operation could reduce it to scrap. In addition, the resulting delay might seriously disrupt our customer's production schedules.

These are only two of the reasons why Red Ring Broaches are heat-treated in our own plant under control of our own metallurgists. Here we have equipment especially designed and selected for just this type of work. Here we have an organization with a background of know-how that has been building up for the last 30 years.

Complete control over every production operation by men who KNOW broaches, gives the Red Ring Broach that extra precision—that extra service life—that added economy for the user.

See the cover illustration of American Machinist, November 4 issue.

7983

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

be a Profit prophet ...without Crystal Ball!

Users of U. S. Adjustable Drill Heads are unusually accurate in anticipating profit pictures— they regularly figure lower and *more dependable costs.* That's because these high-quality heads—priced right to start with—usually cost less to maintain, less to operate.

The U-1 Head shown has 8 drivers, ¼" drilling capacity in cast iron, 6" diameter drilling area. With 2 spindles and Erickson chucks, it costs only $260.

And that's because ALL U. S. Heads of this type have these plus features:

SHAVED GEARS for smooth, quiet operation.
SPECIAL UNIVERSALS with heat treated joints, neoprene sealed and lubricated for life.
ALUMINUM BODY CASTING with special 33,000 lb. tensile.
GREATER BEARING AREA for the spindles.
QUICK CHANGEOVER for different hole patterns.
SLIP SPINDLE PLATE, providing the advantage of a fixed center head on long runs.

Write for catalog AD-57. Immediate delivery on most standard sizes.

Adjustable and Fixed Center Multiple Drilling Heads
Individual Lead Screw Multiple Tapping Heads

US DRILL HEAD

UNITED STATES DRILL HEAD CO.

BURNS STREET • CINCINNATI 4, OHIO

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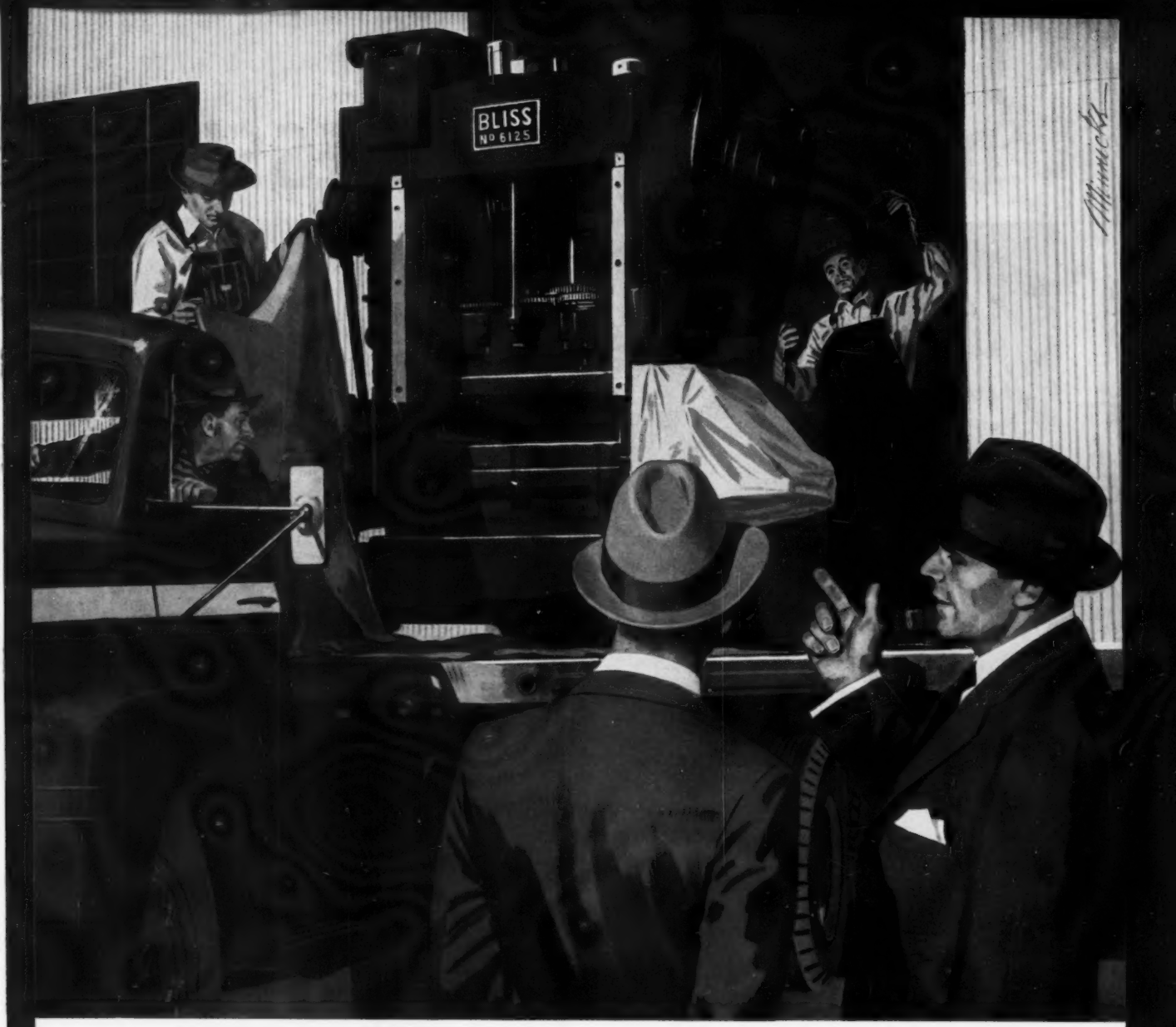


"The Board balked at first...

but I convinced them that now was a good time to buy!"

When machine tool builders work with smaller backlogs they're naturally more efficient and can make better deliveries... are more able to control costs ...more able to render the many *extra* custom engineering services that disrupt regular production during peak schedules. As a matter of fact, many progressive buyers are at their busiest now... taking advantage of the sound buying position the economy gives them as it pauses for its breath... seizing the opportunity to get ready for tomorrow today.

BLISS
SINCE 1857

E. W. BLISS COMPANY · Canton, Ohio

BLISS is more than a name... it's a guarantee

PRESSES • ROLLING MILLS • ROLLS • DIE SETS • CAN MACHINERY • CONTRACT MFG.

ROCKWELL-BUILT

DELTA 20" DRILL PRESSES

Multiple spindle set-ups
do the work of machine tools costing twice as much

Making heavy-duty staplers and industrial stitchers calls for precision drilling operations and production line ruggedness. At Bostitch Inc., East Greenwich, R. I., five multiple spindle Delta 20" drill presses (6 spindles each) work alongside machine tools costing twice as much. And, according to John Larke, Chief Methods Engineer, "Delta fills the bill at surprisingly low cost."

COST CUTTING EXTRAS offered by these versatile Delta tools include five speeds, easy "up front" speed changes and independently powered spindles for greater protection against downtime due to motor trouble.

"CATALOG ENGINEERING—buying Delta tools by components instead of complete units—gave us production tooling to meet our exact needs," says Mr. Larke. Using six 20" Delta spindle heads mounted on a standard 17" drill press production table minimizes work transfer operations and saves valuable floor space.

See Delta drill presses and a complete line of industrial metalworking tools and accessories at your nearest Delta Dealer . . . he's listed under "TOOLS" in the Yellow Pages. Choose from the WORLD'S MOST COMPLETE LINE of drill presses: 20", 17", 15", 14" and 14" Super-Hi Speed in floor, bench and overhead models.

Learn how YOU can cut costs with Delta Industrial Tooling—write for FREE Drill Press Catalog to: Rockwell Mfg. Co., Delta Power Tool Div., 14r N. Lexington Ave., Pittsburgh 8, Pa.

DELTA POWER TOOLS

another fine product by

ROCKWELL

For more information fill in page number on Inquiry Card, on page 179

People buy Scott Wipers for many reasons:

Mr. R. J. Stuart, Jr., Vice President, Messinger Bearings, Inc. says: "Scott Wipers meet our needs very well. We use them for many different wiping jobs, such as the wiping of finished bearings before inspection, wiping grease and dirt from turret lathes, keeping the hand wheel of a 144" boring mill clean plus all general clean-up wiping.

Messinger Bearings likes the safety and sanitation of Scott Wipers!

Messinger Bearings, Inc., Philadelphia makes precision bearings for the steel and machinery manufacturing industries, bearings for radar units, shipboard gun turrets, air force and army equipment. They've used Scott Wipers for the past two years. Mr. R. J. Stuart, Jr., Vice President, says: "There's a danger of metal chips in cloth wipers—chips that might cut an employee's skin, cause infection. We introduced Scott Wipers to eliminate this hazard, and to keep our men happy." Soft, absorbent two-ply paper Scott Wipers are always fresh from a box. They're disposable after use. At Messinger, Scott Wipers have helped improve morale, plant housekeeping and inspection work because the *uniformity* of Scott Wipers increases wiping efficiency.

Your Scott distributor has the complete Messinger Bearings case history and many others, covering many fields. He's in the Yellow Pages under "Paper Towels." Or write: Scott Paper Company, Dept. M-86, Chester, Pennsylvania.

SCOTT PAPER

See "Father Knows Best" on NBC-TV.

This valve gets a leak-proof seal from a Blanchard Surface Grinder

"The Blanchard Surface Grinder is one of the most important improvements in our modernization program." This report comes from the Commercial Refrigeration Division of Bendix-Westinghouse Automotive Air Brake Company—makers of power and condensing units for refrigeration equipment.

The Blanchard No. 18 Surface Grinder puts a surface of 5 micro inches or better on Bendix-Westinghouse valves at the rate of 75 pieces an hour.

A Blanchard Model 18 Surface Grinder is used to finish grind valve plates used in Bendix-Westinghouse electric refrigeration compressors. They say: "This operation is very important, because—with a surface finish of five micro inches or better—we get a perfect seal on our gaskets and valves, eliminating the possibility of leakage."

Is there room for improvement in *your* surface grinding? For best results...

Write today for your free copy of "Work done on the Blanchard," fifth edition, and "The Art of Blanchard Surface Grinding," fourth edition.

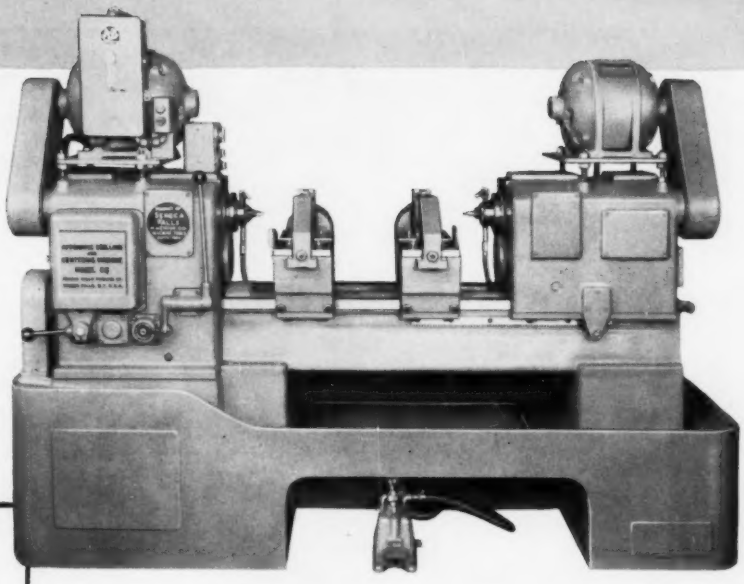
PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY

64 STATE ST., CAMBRIDGE 39, MASS., U. S. A.

For more information fill in page number on Inquiry Card, on page 179

How this manufacturer got his CENTERING MACHINE for nothing



BUILT-IN FEATURES OF MODEL "CS" AUTOMATIC CENTERING MACHINE

- Positive control of center depth to +.001".
- Accurate location of the work piece to assure correct center depth at both ends.
- Correct angle and perfect alignment of center holes.
- Double action feed cam to produce a smooth cleanly finished center hole.
- Quick change-over through pre-set graduated cams.
- Complete automatic cycle, 100% mechanical.
- Automatic work handling equipment available.

who?

A valued customer needed five Seneca Falls Model "LQ" Automatic Tracer Lathes to turn miscellaneous shafts in average sized lots. He had a tight budget for the machines, but when the cost of a quantity of endwise locating devices was added, there was a real strain!

how?

He substituted a Model "CS" Automatic Centering Machine (to maintain overall shoulder lengths), eliminating any need for the more costly locating devices.

He is now the happy owner of a super-accurate, versatile Centering Machine that every day is saving money around his shop.

can you

afford *not* to own a Model "CS" Centering Machine when you can pay for it quickly out of savings?

Write for your copy of Bulletin CS-47.

SENECA FALLS MACHINE

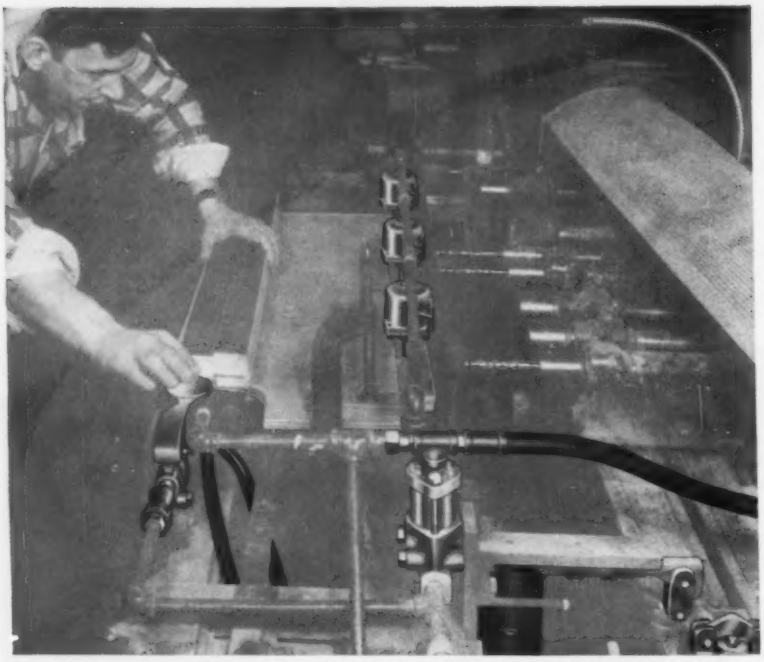
ENGINEERED FOR PROFIT

SENECA FALLS MACHINE CO.

SENECA FALLS, NEW YORK

Lo-swing Lathes and Seneca Falls Machine Tools, Automation and Electronics

ECONOMIZE ON YOUR GANG-TOOLING WITH STANDARD SCHRADER AIR PRODUCTS

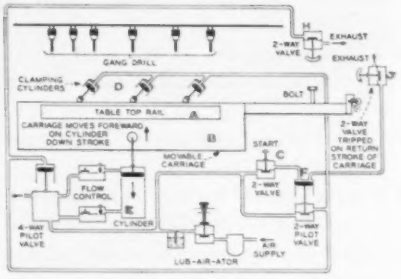


Many plants use air to plan their own gang-tool units. They design them with standard Schrader parts and save money. They know it pays to think "air" whenever they automate such jobs as holding, moving, tripping, feeding, ejecting.

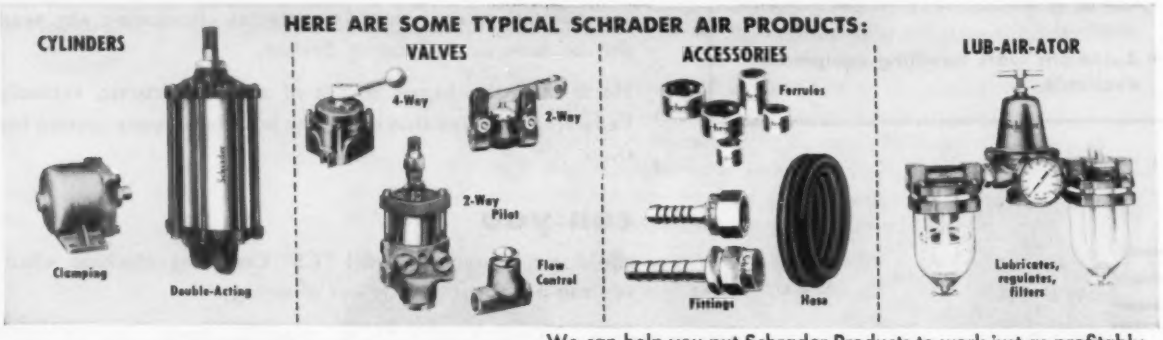
Air pays off because it is also safe, fast, and accurate ... as well as versatile and economical. Use it for the trickiest jobs in the shop. Schrader air specialists will help you select the *right* components from the most complete line of air products.

ANOTHER TYPICAL SHOP PROBLEM SOLVED BY STANDARD SCHRADER PRODUCTS: Six holes had to be drilled in table tops. How to increase production and speed up the drilling, without increasing costs? Operator places tabletop rail A on movable carriage B and presses valve C. Clamping cylinders D hold rail in position. Cylinder E advances carriage to drills. Holes are drilled in rail to exact depth. Carriage returns to position when valve H is tripped and reverses 4-way valve. Valve J exhausts pilot valve F and clamping cylinders release rail.

RESULT: Production increased 80% with an economical Schrader-controlled fixture.



HERE ARE SOME TYPICAL SCHRADER AIR PRODUCTS:



Schrader®
a division of SCOVILL

We can help you put Schrader Products to work just as profitably and our Distributors are conveniently located for fast delivery. Information is available by writing directly to us—

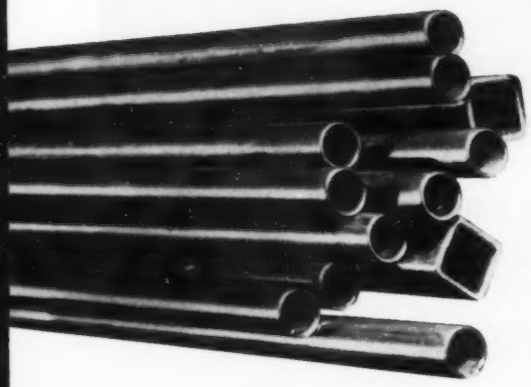
A. SCHRADER'S SON, *division of Scovill Mfg. Co., Inc.*
454 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

For more information fill in page number on Inquiry Card, on page 179

"Whom do I call for mechanical tubing?"

"Why, your USS Shelby Distributor, of course!"



When a steel tubing problem confronts you, get in touch with your Shelby* Distributor. His ideas, experience and engineering know-how will prove most valuable.

Your Shelby Distributor carries a complete stock of USS* Shelby Seamless Mechanical Tubing—round, square, rectangular, or other special shapes in commercial sizes from 1/4" OD to 10 3/4" OD. Wall thicknesses from .035" to 2.000" in a wide range of steel grades and anneals.

So contact your USS Shelby Distributor. He is experienced, capable and close at hand. He gives speedy, efficient service. Contact him!

"Shelby Tubing is made by the world's largest and most experienced manufacturer of tubular products—National Tube."

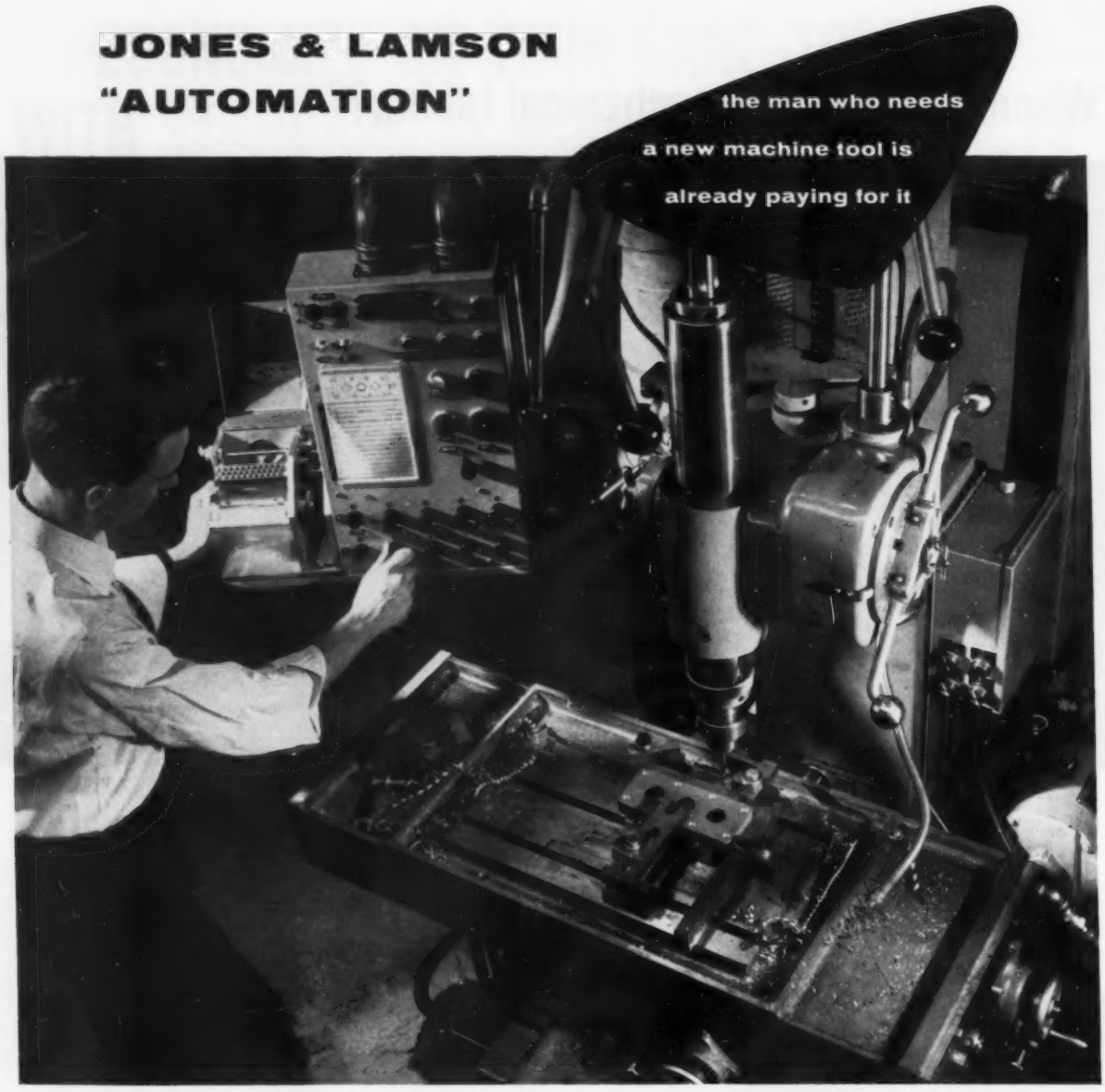
National Tube
Division of USS United States Steel

*TRADEMARK

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Supply Division
United States Steel Export Company, New York

JONES & LAMSON

"AUTOMATION"



This tape-controlled table eliminates set-up time on small lots

It's natural enough, in a way, to associate "automation" with huge plants and their long, high-speed production lines.

We should also keep in mind, however, that certain "automation" techniques offer tremendous benefits to the *small job shop*. Jones & Lamson research and development have produced remarkable results in applying "automation" to small-lot production.

Are you interested in drastically cutting set-up and change-over time, and greatly increasing your small-lot flexibility? We'd be pleased to show you how the results of our intensive research and development programs can be put to good use in *your* operations.

Write for literature. JONES & LAMSON MACHINE COMPANY, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Fay Automatic Lathes • Precision Boring Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

ANNOUNCING!

VICKERS® New ¼" Temperature and Pressure Compensated FLOW CONTROL VALVE

ANOTHER VICKERS FIRST

FOR OPERATING PRESSURES UP TO 2000 psi

For years the Machine Tool Industry has been asking for a combination Temperature and Pressure Compensated Flow Control Valve to insure CONSTANT FEED RATES. Now for the first time it is available as a production unit at a reasonable price.

Check THESE EXCLUSIVE FEATURES that mean Optimum Tool Life and Better Work Finish:

☑ **TEMPERATURE COMPENSATED**
Constant feed rates all day long with same throttle setting because throttle automatically compensates for changes in oil temperature. The compensator mechanism is simple in design and durable.

☑ **PRESSURE COMPENSATED**
Constant feed rate throughout entire cycle because built-in pressure hydrostat automatically compensates for load changes.

☑ **SINGLE THROTTLE COMPLETE RANGE ADJUSTMENT**
Greater flexibility because valve is adjustable within entire flow range of 5 to 1000 cubic inches per minute.

☑ **REVERSE FREE FLOW AS STANDARD FEATURE**
A standard feature which permits reverse free flow (up to 1400 cu. in. per min.) from outlet to inlet port by-passing control elements.

☑ **TAMPER-PROOF ADJUSTMENT**
Retension of original feed rate is assured because a set screw prevents inadvertent throttle movement and a cover over the set screw can be locked in place.

☑ **INTERCHANGEABLE**
This new valve replaces 12 previous models and it is interchangeable with all of them, also the drain connection is eliminated on the new valve to simplify piping.

☑ **GREATER ECONOMY**
No need to stock several valves for wide range of flow rates. Drain connection is eliminated, piping costs are reduced.

☑ **MAXIMUM RELIABILITY AND ACCURACY**
Design of temperature and pressure control components assures maximum circuit reliability and extreme accuracy of feed through a range of 5 to 1000 cubic inches per minute.

FOR ADDITIONAL INFORMATION SEND FOR I-195040 7945

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1403 • Detroit 32, Michigan

Application Engineering Offices: ATLANTA • CHICAGO • CINCINNATI CLEVELAND • DETROIT • GRAND RAPIDS • HOUSTON • LOS ANGELES AREA (El Segundo) • MINNEAPOLIS • NEW YORK AREA (Springfield, N.J.) PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) PORTLAND, ORE. • ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE • ST. LOUIS • TULSA • WORCESTER
FACTORIES ALSO IN AUSTRALIA, ENGLAND, GERMANY AND JAPAN
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto, Montreal and Vancouver

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

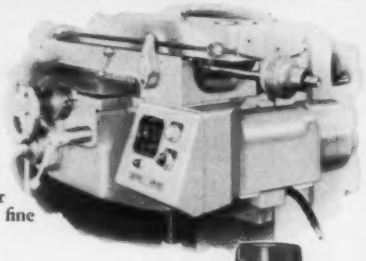
For more information fill in page number on Inquiry Card, on page 179

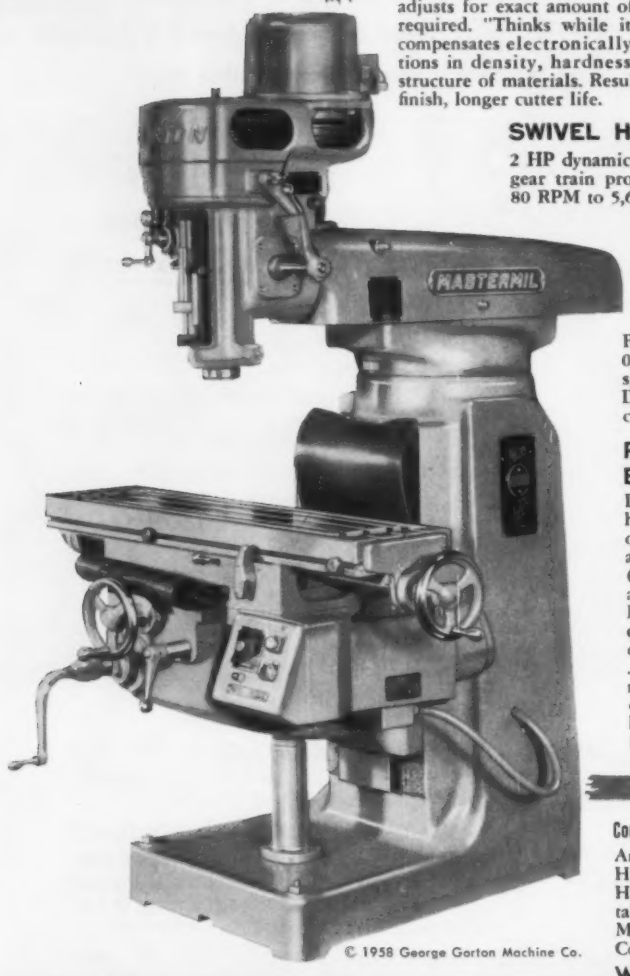
Eventually you'll buy a GORTON MASTERMIL

here's why

DYNA-DRIVE
"The Torque-Thinking" Table Feed

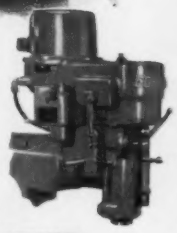
"Feels as it feeds"... automatically adjusts for exact amount of torque required. "Thinks while it works", compensates electronically for variations in density, hardness, molecular structure of materials. Result: Superbly fine finish, longer cutter life.





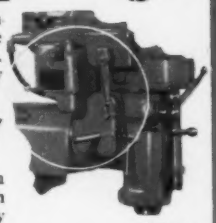
SWIVEL HEAD

2 HP dynamically balanced motor with belt and gear train provides wide range of speeds from 80 RPM to 5,600 RPM. Head swivels 90° left or right, head, ram and turret rotate 180°. Cross movement 14 inches. Push button starting.



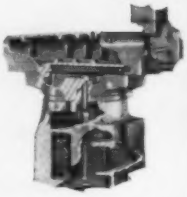
DOWN FEED INFINITELY VARIABLE

Feeds may be varied infinitely from 0" to 5" independent of spindle speeds. High efficiency belt drive. Direction and rate of feed separately controlled.



PERMANENT ACCURACY BUILT-IN

Distortion is prevented by extra heavy one-piece column cast with over-size ribbing . . . extra heavy alloy steel turret clamping bolt (1⅜" dia) with 3-point clamping action . . . heavy dovetail way full length of vertical column face . . . extra large table, knee and 24" saddle (2" longer than table travel) . . . square lock bearings with long, narrow guide between knee and saddle . . . positive locks . . . extra heavy feed screws . . . bearing surfaces hand-scraped.



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Complete Versatility Through Attachments Built-In or Field Installed.

Among such equipment is, Trace-Master Hydraulic Tracer Control, Duplicator Tracer Head and/or Table with base, saddle and table in one unit, 6" Raising Block, End Measuring Rods and Dial Indicators, Self-Contained Coolant System.

Write for Bulletin 2699-1306.

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Tracer-Controlled Pantographs, Duplicators — standard and special . . . Horizontal and Vertical Mills, Swiss-Type Screw Machines, Tool Grinders, Small Tools and Accessories.

A8-1008

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ANOTHER CUSHMAN PINCH JAW CHUCK AT WORK!

Cushman has designed and engineered a complete line of both automatic and hand operated pinch type chucks featuring pinch units which exert gripping pressures of over 2,000 lbs at 85 p.s.i., with workpiece lift limited to less than .0002". While these chucks were primarily designed for precision machining jet engine discs and rings without distortion or strain, they are extremely adaptable and are equally suited to a range of products from rings of small cross section to large complicated weldments.

CUSHMAN CHUCKS,
a product of American quality, labor and materials.

Sold through your industrial distributor.

THE CUSHMAN CHUCK COMPANY

hartford 2, conn.

ARMSTRONG

Drop Forged CLAMPS

LEADERS IN THE DROP FORGED CLAMP FIELD . . . in design, machining and strength; in completeness of line in both sizes and types.

Designs are based on a full knowledge of clamp uses and requisites. Drop forging assures die-perfect form, texture toughness and freedom from structural faults. Maximum stiffness is attained by a discerning selection of steels with accurate controlled heat-treating, tempering and testing.

For dependability and long useful life, specify and standardize on ARMSTRONG Drop Forged Clamps.

EXTRA DEEP THROAT "C" CLAMPS

Provide extra clearance required for some work. Extremely stiff for weight. Screws and hubs are accurately machined and aligned with machined seats; have sliding pin handles and free-acting swivel caps on point. Bodies have smooth sandblast finish.
(8 sizes to 12" opening)

Write for new ARMSTRONG General Catalog showing almost 5000 industrial tools.

ARMSTRONG BROS. TOOL CO.
5213 W. ARMSTRONG AVE. • CHICAGO 46, U.S.A.

HEAVY DUTY "C" CLAMPS

Universally recognized as strongest "C" clamps made. Longer hub holds screw alignment against terrific side strain; permit tighter clamping and multiples thread friction against loosening. Extra large screws are heat treated and hardened at point.
(11 sizes to 12½" opening)

MEDIUM SERVICE "C" CLAMPS

The design and careful selection of steels in this type clamp combine to give it maximum strength and stiffness consistent with convenient weight. Heat treated screw with sliding pin handle and swivel cap on point. Ground seat.
(9 sizes to 18" opening)

TOOL MAKERS "C" CLAMPS

Quality steels, drop forged, heat treated and accurately machined with ground seats. Drop forged screws have both "wing nut" handle for convenience and square necks for tight setting with a wrench. Either "plain" or "swivel" screw types.
(Four sizes: 1", 2", 3" or 4" maximum opening)

SPATTER RESISTANT WELDERS "C" CLAMPS

Extra Deep Throat Pattern (see above). Body, Swivel and Screw are cadmium plated over all to resist welding spatter.
(8 sizes Capacities to 12" opening)

MACHINISTS' CLAMPS

Jaws drop forged, carefully machined and hardened, are extra heavy; will not bend or spring on a short bite and are faced true. Will grip non-parallel surfaces because the under face of the center screw is convex, fitting into a concave seat for tilting.
(Four sizes: Capacities to 4¼" opening)

PARALLEL CLAMPS

Carefully machined from selected grade steel and hardened. Particularly suited for holding work together when drilling or tapping. Rounded jaw ends increase clearance in close quarters. Spring clip holds loose pin in alignment while tightening or loosening.
(3 sizes: Capacities to 2½" opening).
(Not Drop Forged)

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Continuous high production plus precision are built into this CTU cylindrical grinder.

You, too, can have the "Touch of Gold" with a Norton Grinding Machine

This is one of the most profitable machines industry knows. It is widely used for the demanding tasks of production precision cylindrical grinding. It is a product of Norton Company's ingenuity and knowledge of the great and varied science of grinding . . . one in which Norton has specialized for scores of years . . . a field in which it has become world leader.

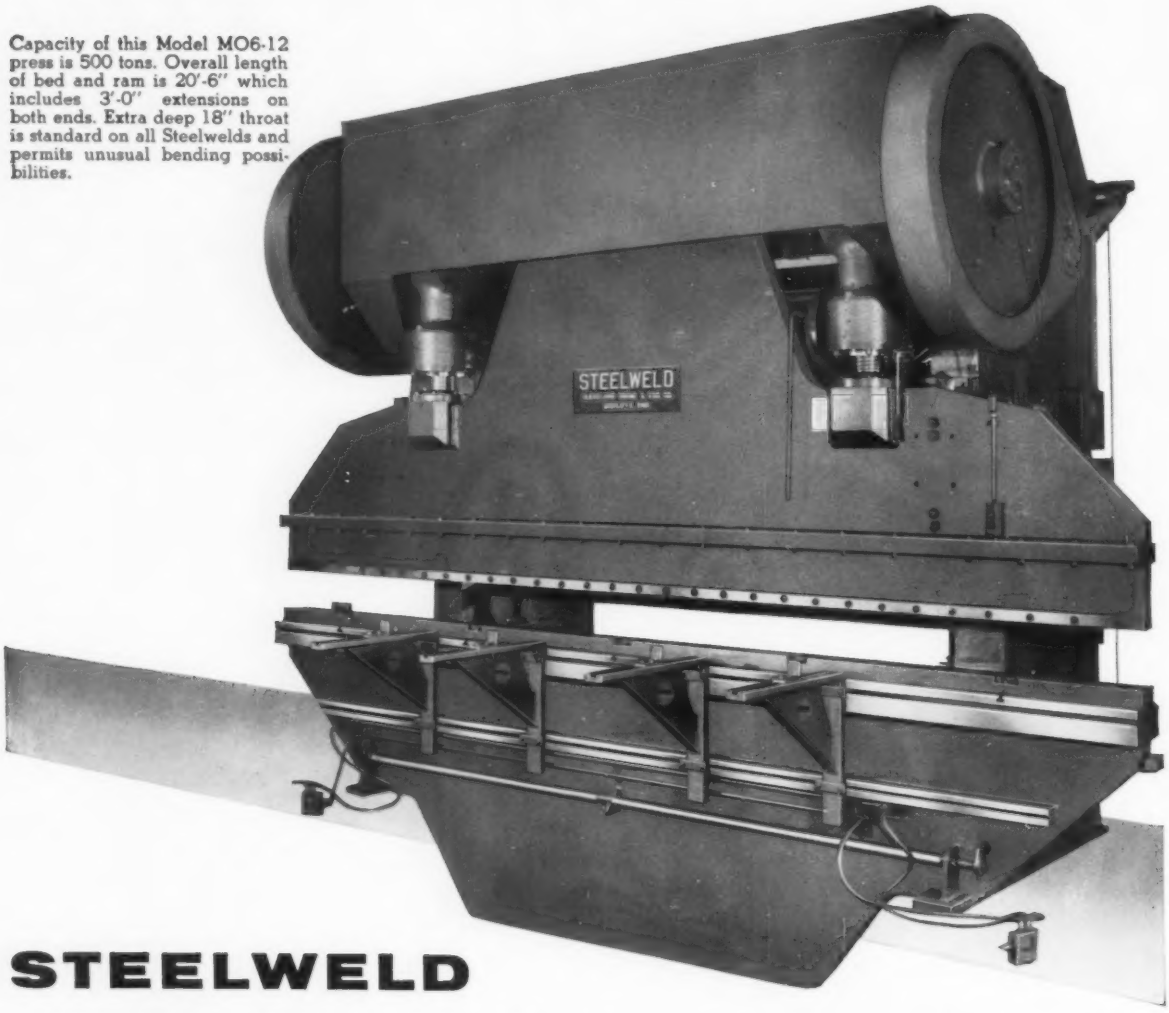
You literally have the "Touch of Gold" when you use a Norton Grinder. Its ability to produce faster and with greater precision is added value that creates more wealth . . . helps everybody earn more.

It will pay you to inquire how Norton Grinding Machines and Lappers can give your company the "Touch of Gold." NORTON COMPANY, Worcester 6, Massachusetts.

NORTON
GRINDERS and LAPPERS

Making better products...to make your products better

Capacity of this Model MO6-12 press is 500 tons. Overall length of bed and ram is 20'-6" which includes 3'-0" extensions on both ends. Extra deep 18" throat is standard on all Steelwelds and permits unusual bending possibilities.



STEELWELD

PRESS BRAKE Designed For Special Gooseneck Punch and Standard Dies

THIS Steelweld Brake was designed to take a special gooseneck punch and, for this reason, has a shut height of 30 inches. However, it will also accommodate standard dies because the ram is provided with an extension, as shown, which brings the shut height down to 16 inches.

The bed has a slide rail on which is mounted four brackets, adjustable up and down and along the bed, for supporting materials going through the machine. The brackets have adjustable stops that enable gauging the width of metal being formed.

STEELWELD

PRESS BRAKES

Like all Steelweld Brakes, this press was designed to permit hairline accuracy. Under full load the average deflection will not exceed .001 inch per foot between housings. An important reason for this accuracy is the unusually rigid frame which was fabricated entirely of rolled steel plate and welded into a one-piece integral unit. Another is the extra deep bed which extends 2'-6" below the floor.

The machine has a 6-inch stroke with two speeds of 7 and 20 strokes per minute. The clutch is air-operated and controlled by two foot-operated valves. A reversing flywheel permits reversing the ram at any position of the stroke.

The Steelweld Brake design is readily adaptable to suit special requirements. Our engineers will be glad to work with you on press brake and heavy stamping problems.

Write for free copy of Catalog No. 2010

STEELWELD DIVISION • THE CLEVELAND CRANE & ENGINEERING CO • 5467 E. 281 ST. • WICKLIFFE, OHIO

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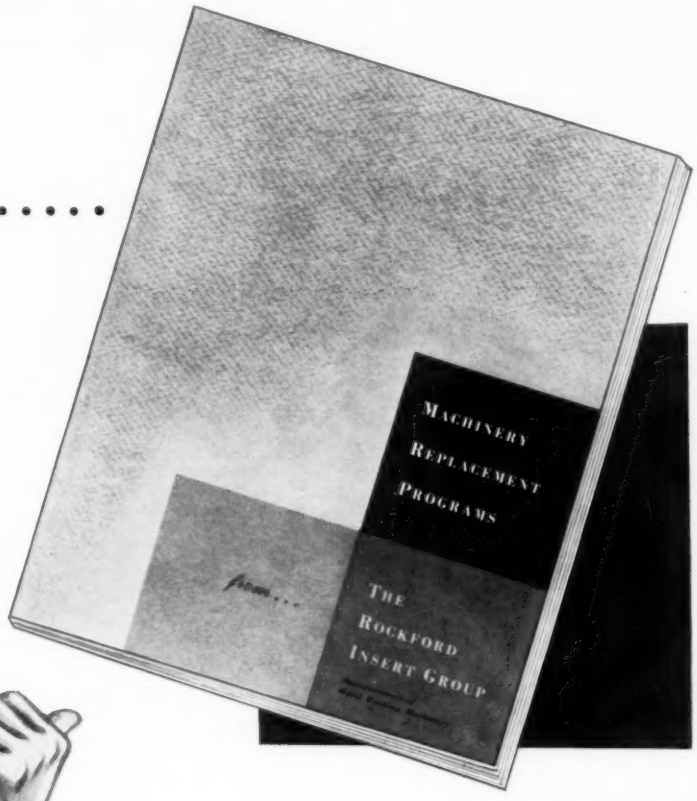
if you are responsible for machinery and equipment buying

GET THIS BOOK

Eighteen prominent industrialists discuss their machinery and replacement programs in this book. This valuable information represents the most up-to-date collection of evidence of the importance of such programs in industry today. For your free copy, merely write to any one of the companies in the Rockford Insert Group.



Rockford Insert Group

A word about the Beloit College Seminar

Arrangements have been finalized for MAPI'S fourth annual Summer Seminar on Dynamic Equipment Policy to be held the week of July 14, 1958, at Beloit College, Beloit, Wisconsin. This year, in addition to the usual intensive course in the theory and practice of equipment analysis, MAPI Research Director George Terborgh will discuss in detail his expanded and generalized approach to business investment policy. Based on the same general principles as *Dynamic Equipment Policy,* this reformulation makes available broadened and improved applications of the MAPI "formula."

For further information on the Seminar, write the Machinery and Allied Products Institute, 1200 — 18th Street, N. W., Washington 6, D.C.

Keep gathering metal working production ideas... be well informed when you replace machinery

June, 1958

MATTISON MACHINE WORKS
ROCKFORD ILL. U.S.A.

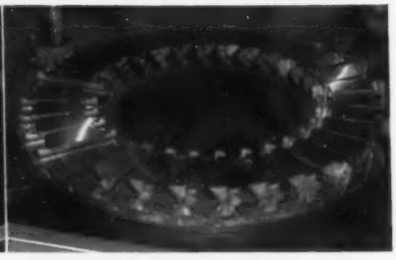
GRINDING METHODS

When you want to machine flat surfaces

consider the profitability of high-powered surface grinding: lower tool costs . . . simpler work handling . . . faster machining!

262 high-speed steel reamer blades are ground every chuck load, holding size and flatness within .0003 in. Wheel is set dead flat, producing 10 to 12 micro inch finish, using a 60-grit segmental wheel.

Two sides of hardened steel retainer rings are ground at 100 per hour, holding size to plus .000, minus .003 in. Stock removal is .030 in.



Change from milling to surface grinding saved 22¢ per piece on 4140 drop-forged chain links. Production is 100 pieces per hour, with .140 in. stock removal. Saving in cutter maintenance alone is 16¢ per part.

The more metal you machine, the higher the cost. This is why many companies are switching to high-powered surface grinding for machining flat surfaces ordinarily milled, planed, or broached.

And why not? The grinder will take them from the rough, getting under tough scale and cutting through hard spots with no danger of tool breakage. It's often only a matter of reducing stock allowances or a slight redesign of the part to make an ideal grinding job. With castings costing by the pound, the savings in material costs alone can make grinding an attractive investment.

What's new in surface grinding that challenges other stock-removal methods? There are two things: (1) Grinding wheels are tougher, and (2) machines are available with spindle motors up to 150 hp and more than enough rigidity to apply this power profitably.

Take the Mattison Vertical-Spindle Rotary, for example. Spindle motors up to 60 hp are being used. Large, uninterrupted surfaces such as those shown above are being ground with a minimum of wheel clearance. This means greater flatness. Finishing cuts are taken with the wheels set dead flat. High unit pressures keep the wheel self-dressing, hogging off metal with an open structure wheel. This eliminates wheel loading and reduces surface checking. Think of what this means in terms of tool cost when machining tough forgings and castings from the rough. Not only is tool breakage eliminated, you save sharpening costs and reduce downtime.

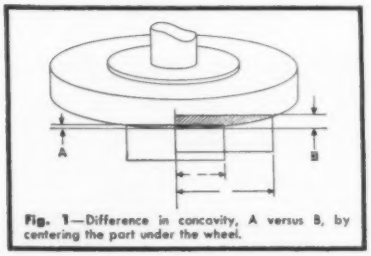
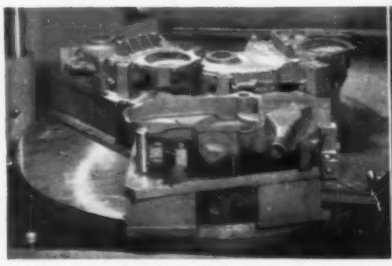


Fig. 1—Difference in concavity, A versus B, by centering the part under the wheel.

Another factor is direct costs. On a surface grinder, large or small pieces can be set up on a magnetic chuck and ground in less time than it takes the operator to locate them and clamp them in a fixture. But perhaps the greatest saving is in reduced scrap or increased accuracy for faster assembly of your product. This happens often, especially on thin-walled parts where an interrupted cut by a conventional cutting tool overstresses the part, or where clamping pressures distort the part prior to machining.

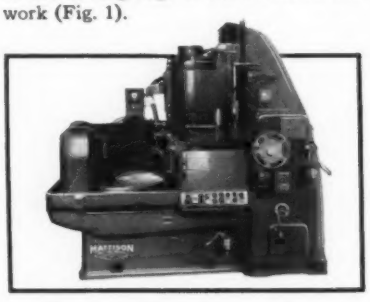


Three faces of cast-iron chain cases are ground in one setup at 13 per hour. Stock removal is ⅛ in. Parallelism is within .001 in. Accuracy is held to .002 in., with automatic sizing.

43 in. diameter Meehanite clutch plates, with 12½ in. uninterrupted friction surface, are ground with wheel set dead flat, using 60-hp spindle motor. Stock removal is .020 in.

Fig. 2—Chips taken on a Mattison Vertical-Spindle Rotary Surface Grinder illustrate positive cut by applying proper horsepower.

If you are interested in improving accuracy and stock removal, don't forget Mattison's exclusive head-tilting arrangement. With it you can get maximum flatness for your optimum loading arrangement by centering the low point of the leading edge of the wheel on the work (Fig. 1).



Fact File on Grinding

Typical parts, setups, and performance reports illustrate flexibility of high-powered surface grinding. Ask for a copy of "Setups," and address your letter to, or call,

MATTISON MACHINE WORKS
Rockford, Illinois • Phone: 2-5521

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

The perfect "throw-away" cutter is a grinding wheel...and it's self-sharpening!

MATTISON HIGH-POWERED PRECISION GRINDING METHODS

Self-dressing wheels and high-powered surface grinders eliminate inefficiencies when machining flat surfaces!

EXAMPLE: 4140 steel forgings, formerly milled at 33 per hour, are now ground on a Mattison No. 24 Vertical Rotary Surface Grinder at 58.6 per hour. Tool replacement cost has been reduced from 39¢ per piece to 4¢. Total part cost was cut from 54¢ per piece to 11¢. Automatic sizing and self-dressing wheel help minimize nonproductive machine time.

When you have flat surfaces to machine, let Mattison evaluate cost reductions and accuracy improvements made possible by high-powered surface grinding.

With recent improvements in grinding wheels—and Mattison has backed them up with increased horsepower at the spindle and plenty of machine rigidity—many jobs which were formerly machined by other methods are being done more efficiently on a surface grinder. For, modern grinding methods permit you to remove up to ¼-in. stock from the rough, with accurate size control and fine finish, holding flatness and parallelism within very close limits.

Cost of the cutting tool is not in the price

By using open-structure wheels which automatically release their grits when they get dull, and with automatic sizing to compensate for wheel wear, you get true perishable tool efficiency. A glance at the table below will show you how reductions in tool-sharpening cost and change time helped trim 43¢ off the cost of forged chain links. Whatever the cost of the wheel, you can afford to use it at maximum efficiency. You never have to "baby" the cutting tool by slowing down your machines. There's no worry about hard spots. You can grind before or after heat-treating.

How to absorb loading time into the production cycle

Many flat surfaces on castings and machine parts can be rough and/or finish-ground on a standard surface grinder at 100 per cent efficiency.

Whenever machining time and loading time are equal, you can absorb loading cost into the production cycle with a duplex table. Using self-dressing wheels and automatic sizing, the Mattison Duplex Rotary gives you remarkable efficiency on a standard machine, plus all of the rigidity needed for high stock removal and generation of accurate surfaces with the wheel set "dead flat."

Tolerances getting tighter

Many companies are switching to surface grinders to combine the advantages of rapid stock removal and accurate size control. On thin-walled parts, particularly, you can eliminate distortion while the part is being ground, holding accuracy within "tenths" limits. The torque converter housing (Fig. 1) is a good example. An open section in the casting made it difficult to mill without springing the ends. Now, flatness and parallelism are easily held within .0015 in.

MACHINING COSTS and PRODUCTION RATES (4140 steel forging)

Machine	Milling Machine	Surface Grinder
PRODUCTION RATE Pieces per hour	33	58.6
(1) MACHINING COST Machining time x (labor + overhead) = (min) x ($ per min)	$.13 per piece	$.05 per piece
(2) TOOL OR WHEEL REPLACEMENT COST (a) Tool or wheel change cost (b) Tool or wheel depreciation cost (c) Tool or wheel sharpening cost	$.15 per piece $.0835 per piece $.16 per piece	$.04 per piece
TOTAL	$.3935 per piece	$.04 per piece
(3) NONPRODUCTIVE COST Loading time x (labor + overhead) = (min) x ($ per min)	$.02 per piece	$.023 per piece
TOTAL MACHINING COST = (1) + (2) + (3)	$.543 per piece	$.113 per piece
SAVING = $.43 per piece		

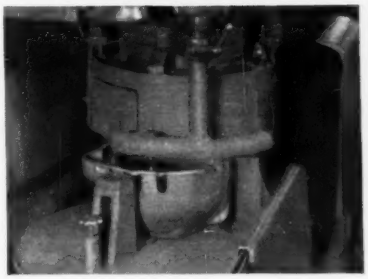


Fig. 1—Saves two milling operations, finish grinding difficult-to-machine castings to close tolerances. Mattison Duplex Rotary Surface Grinder removes .060 to .070 in. stock from top and bottom surfaces of grey iron castings at the rate of 17.4 pieces per hour. One operator and one machine easily do the work formerly requiring two machines.

Fig. 2—Grinding time cut in half on the Mattison "Duplex," roughing Maxel steel shanks for carbide-tipped milling cutter blades. One operator and one machine now do a job that formerly required two operators and two machines. Stock removal is .050 in.

Try before you buy

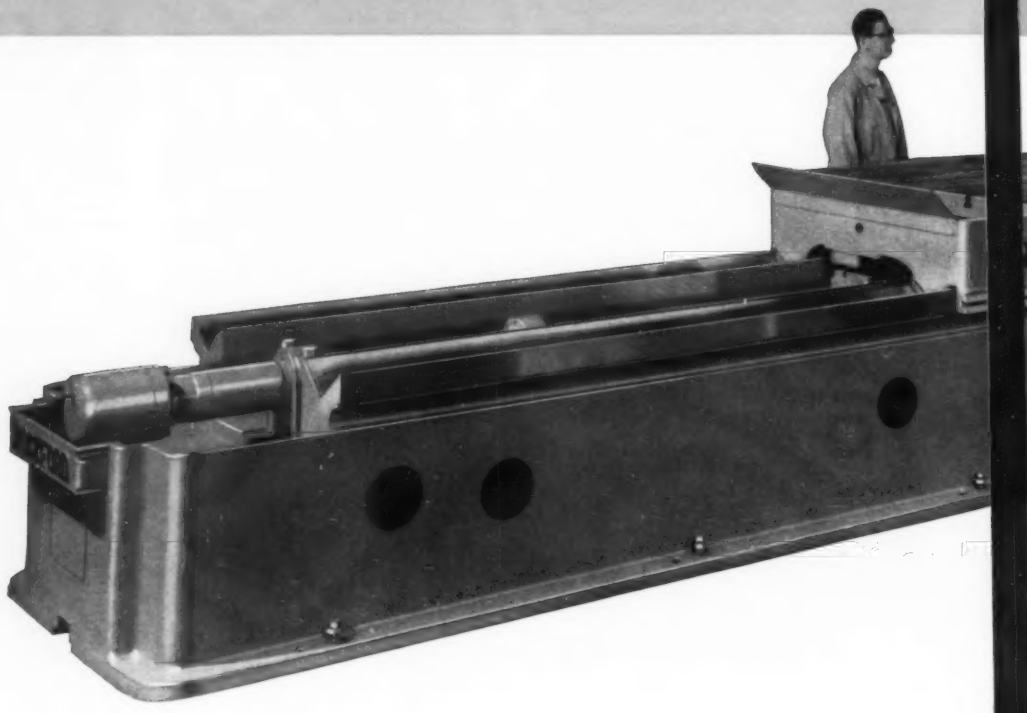
Our engineers will be happy to test grind your flat pieceparts in the Mattison Methods Laboratory. Results of the test will be reported to you in the form of a complete cost evaluation, including production rate, tooling, type of machine best adapted to your work, finish, accuracy, wheel specifications, wheel consumption rate, etc. They will set the job up and demonstrate to you in Rockford the savings made possible on a high-powered surface grinder. There's no obligation—contact your local machinery dealer, or write to:

MATTISON MACHINE WORKS
Rockford, Illinois • Phone: 2-5521

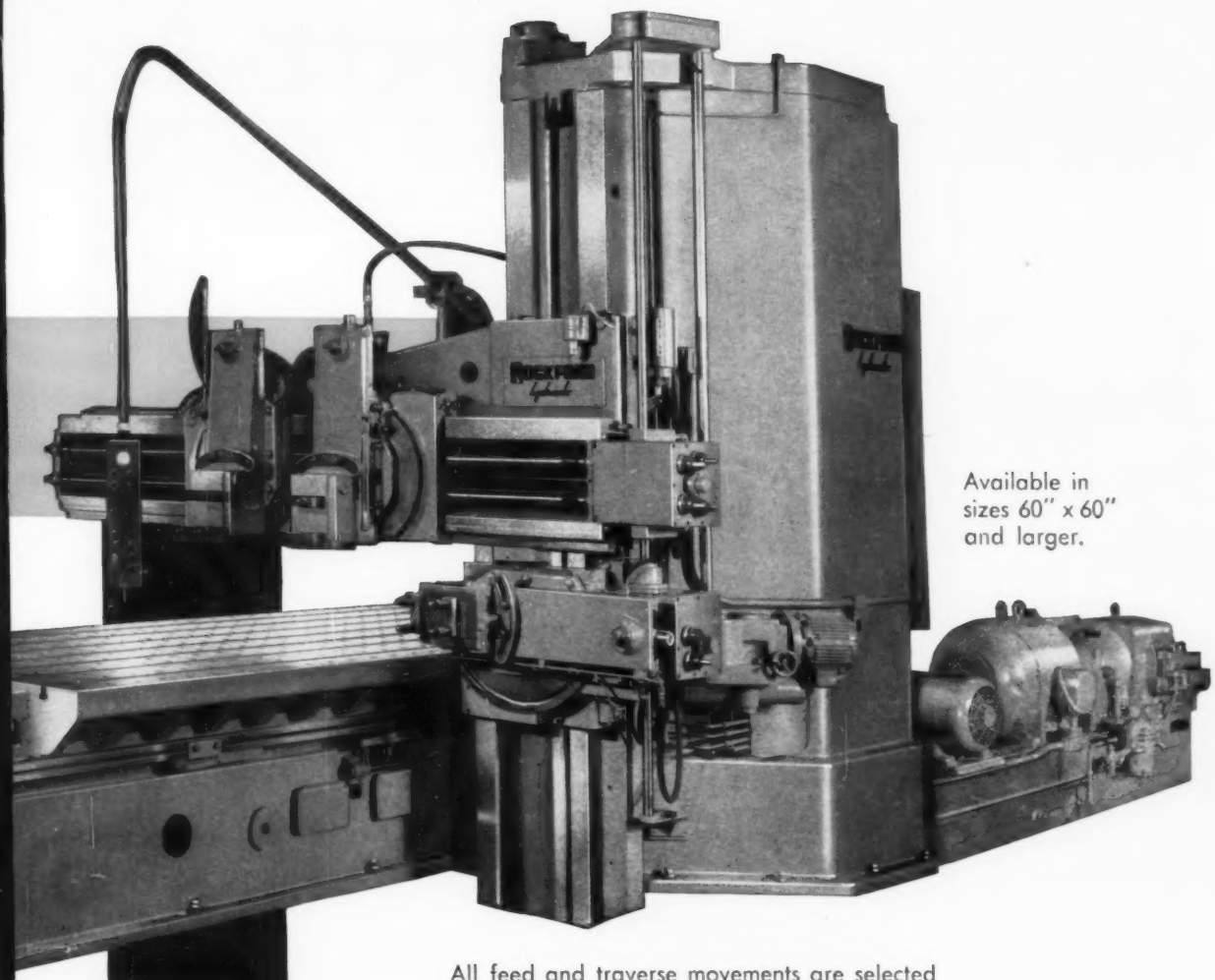
CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

2-speed traverse motors eliminate manual positioning in set-up on

new Rockford Hydraulic Planer



CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**



Available in sizes 60" x 60" and larger.

complete pendant-control speeds operation and set-up

All feed and traverse movements are selected and operated from the push button station of this new Rockford hydraulic planer. Two-speed traverse motors — high speed for approximate positioning, and slow speed for extremely close power positioning of rail and side heads — eliminate the need for manual positioning in setting-up for a job.

Extra-rugged construction affords use of most modern cutting tools and cutting techniques. The machine is equipped with the new high speed h3 triple circuit.

Get full details on the wide production flexibility of this new hydraulic planer from any Rockford Machine Tool Co. representative, or write directly to us.

h HYDRAULIC

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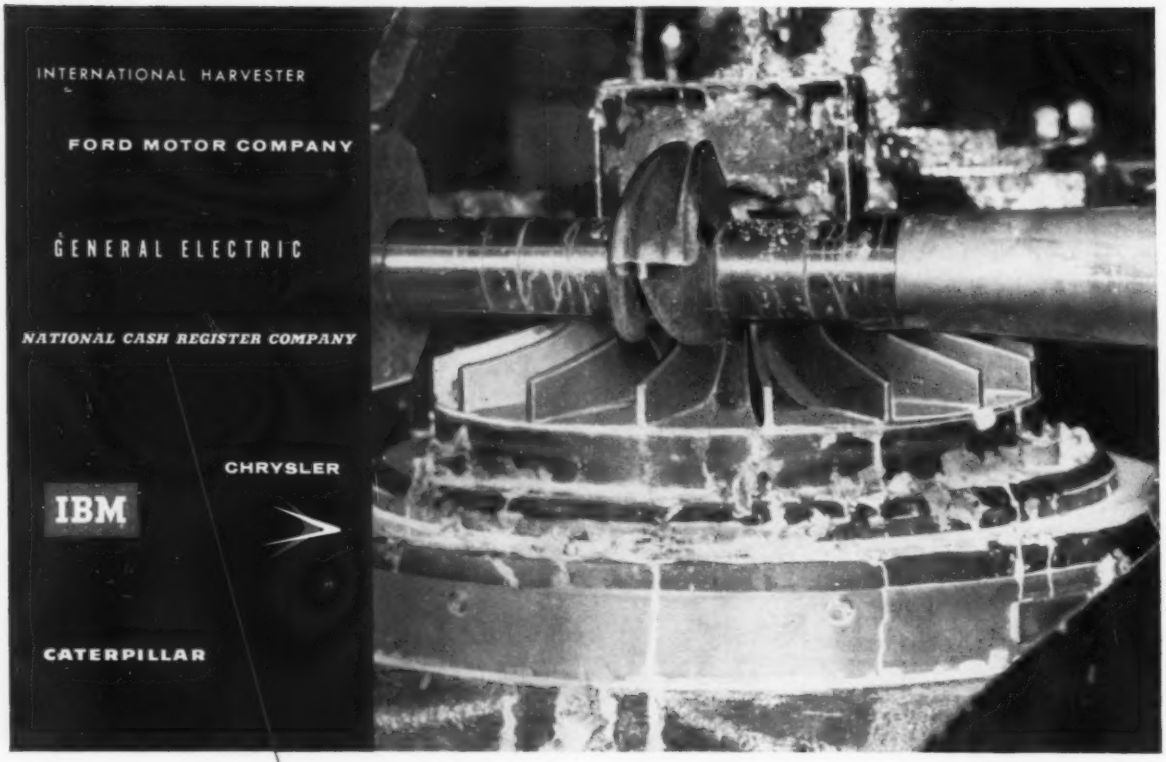
FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

Major production plants reduce costs-per-piece



using BARNESDRILL

COOLANT CLEANING EQUIPMENT

furnished as original equipment on their machine tools.

If you are purchasing new machine tools, or are concerned with maintenance and finishing problems on existing machines, SPECIFY or install BarnesdriL COOLANT CONDITIONING.

Proper coolant supply, conditioned by BarnesdriL Coolant Cleaning Equipment, on machining operations gives *longer* satisfactory machine performance and helps to maintain close tolerances and finish requirements. Results are lower costs-per-piece machined.

BarnesdriL engineers will furnish data to assist you with installation details on any machines built by these O.E.M. builders.

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820 CHESTNUT STREET • ROCKFORD, ILLINOIS
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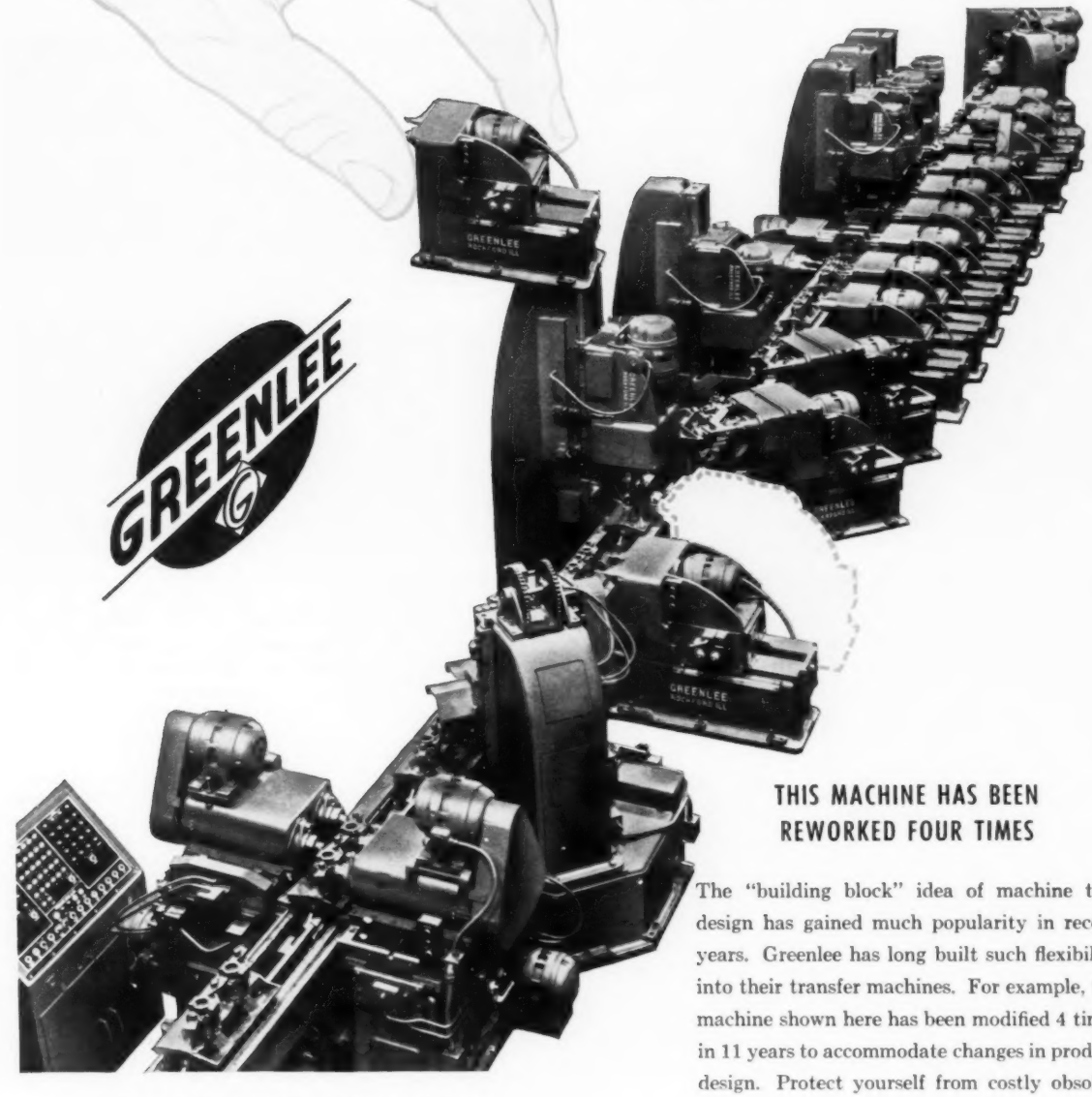
MANUFACTURERS OF MAGNETIC COOLANT SEPARATORS • KLEENALL SEPARATORS AND FILTERS • CENTRAL COOLANT CLEANING SYSTEMS

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

GREENLEE TRANSFER MACHINES

Change with Your Requirements



THIS MACHINE HAS BEEN REWORKED FOUR TIMES

The "building block" idea of machine tool design has gained much popularity in recent years. Greenlee has long built such flexibility into their transfer machines. For example, the machine shown here has been modified 4 times in 11 years to accommodate changes in product design. Protect yourself from costly obsolescence. Ask Greenlee to show you how.

PHONE ROCKFORD, ILLINOIS 3-4881
TO HELP SOLVE YOUR PRODUCTION PROBLEMS

GREENLEE
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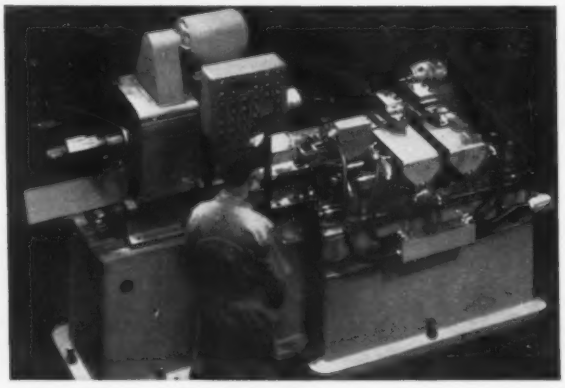
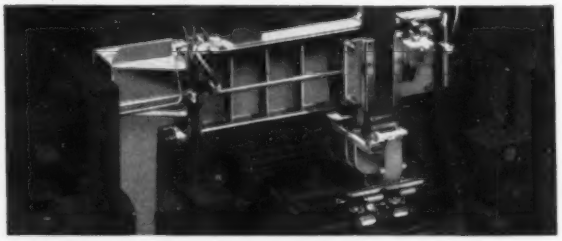
FOR PRODUCTION MACHINE TOOLS IT'S ROCKFORD, ILLINOIS, U.S.A.

Profitable High Production Machining Methods

...from standard machine elements and Sundstrand "Engineered Production"

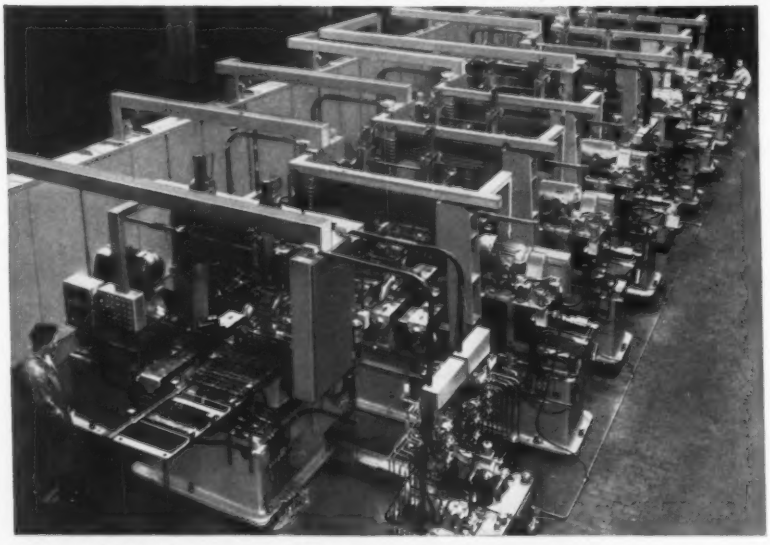
● Basic machine unit in this Sundstrand transfer line is the production proved automatic lathe, specially tooled to provide maximum machining efficiency. Support of the workpiece close to the cut, plus the inherent rigidity of the Sundstrand design, combine to eliminate chatter and improve tool life.





● Third—thru type conveyor is provided for moving parts from one station to the next. Conveyor can be inclined for gravity movement or use positive feed.

● Next, is added the handling system (above right) that lifts work from conveyor automatically and positions it precisely between driving chuck and live center.



THE RESULT is this eight station transfer line using carbides for roughing at stations 1-4 and cemented oxide tools at stations 5-8 for finish turning. Production is over 200 camshafts per hour at 80% efficiency.

That's how Sundstrand "Engineered Production" plus unit construction combine to give you the best buy in high production machine tools. Because the basic elements are "production proved" you're sure performance will meet or exceed specifications.

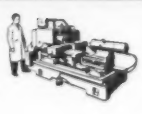
For more examples of Sundstrand cost-cutting transfer lines, write today for your copy of Bulletin 692.

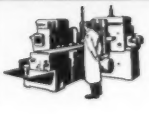
SUNDSTRAND MACHINE TOOL CO.

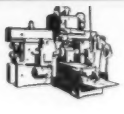
2530 ELEVENTH ST., ROCKFORD, ILLINOIS

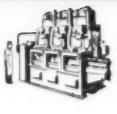
AUTOMATIC LATHES | SIMPLEX RIGIDMILS | DUPLEX RIGIDMILS | TRIPLEX RIGIDMILS | SPECIAL MACHINES

SUNDSTRAND "Engineered Production" Service*



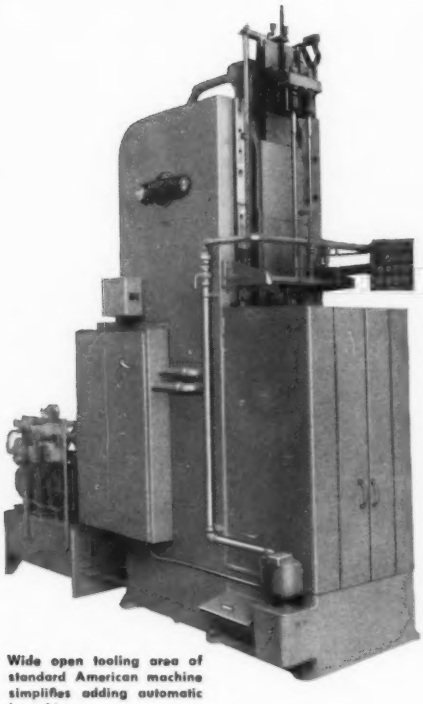




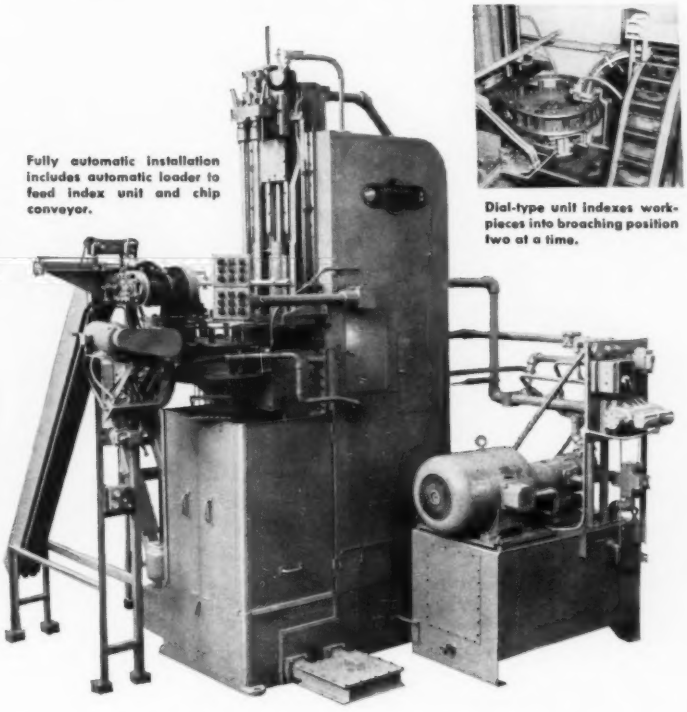


MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

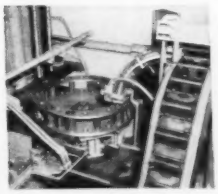
American's Design Features Provide the Basis for Fully Automatic Broaching



Wide open tooling area of standard American machine simplifies adding automatic broaching.



Fully automatic installation includes automatic loader to feed index unit and chip conveyor.



Dial-type unit indexes workpieces into broaching position two at a time.

There's nothing special about the machine at upper right except its ability to turn out a high volume of quality parts. Like the machine at the upper left, it's a standard 25-ton, 54-inch stroke American pull-down machine and was actually used with manual loading in pilot run production before the automation features were added.

Two transmission brake sleeves are broached at a time in a 24-second, fully automatic cycle to produce 300 pieces per hour. All components are electrically interlocked for maximum safety. American machines are designed with a wide open tooling area to permit efficient utilization of fixturing for either semi-automatic or fully automatic broaching. Both the hydraulic package unit consisting of tank, pump, etc., that operates the automatic fixtures, and the separate hydraulic unit required by the machine itself can be floor-mounted where machine is pit installed.

Behind every such successful installation are these three features that are an essential part of American "Engineered Production": (1) proper broach tool design; (2) selection of the best machine for the job; and (3) efficient fixturing. Because American provides these all-important ingredients with no division of responsibility, you are sure to get a highly efficient installation without placing an added burden on your engineering and manufacturing staffs. You get this manufacturing engineering experience and skill at no extra cost. It's just another reason why American gives you the best buy in broaching no matter how simple or complex your installation.

Write today for your copy of Bulletin A-627 describing American pull-down broaching machines.

American BROACH & MACHINE DIVISION

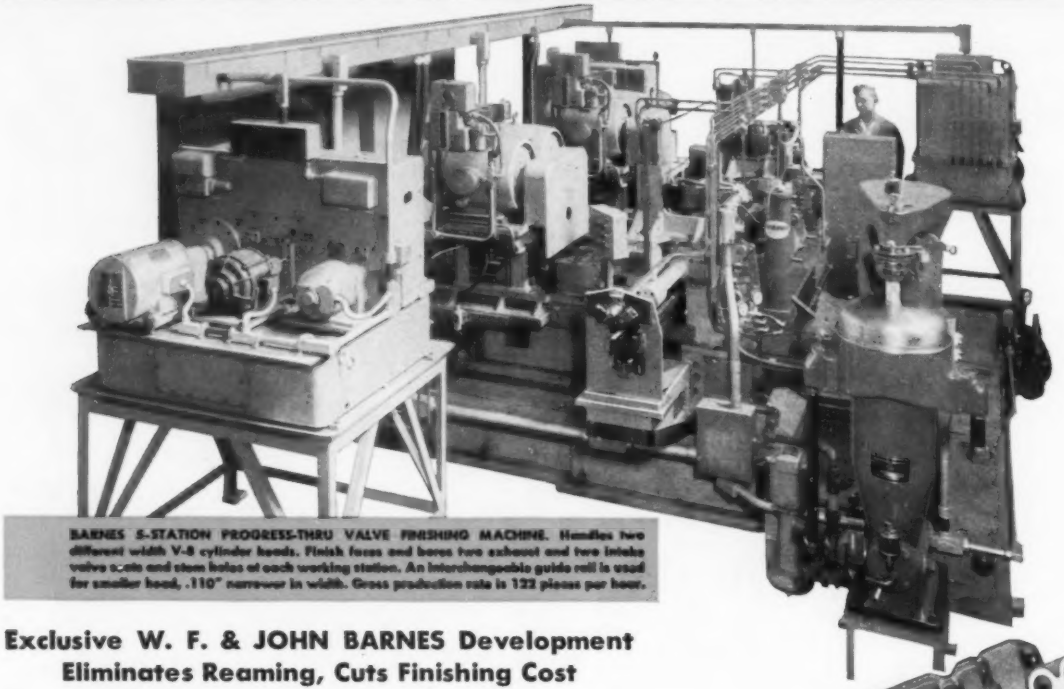
SUNDSTRAND MACHINE TOOL CO., ANN ARBOR, MICHIGAN

BROACHING TOOLS	THREE WAY	SINGLE RAM	HORIZONTAL	DUPLEX RAM	PRESSES

SUNDSTRAND "Engineered Production" Service

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

FINISH-MACHINES VALVE SEAT and STEM HOLES in Single Pass



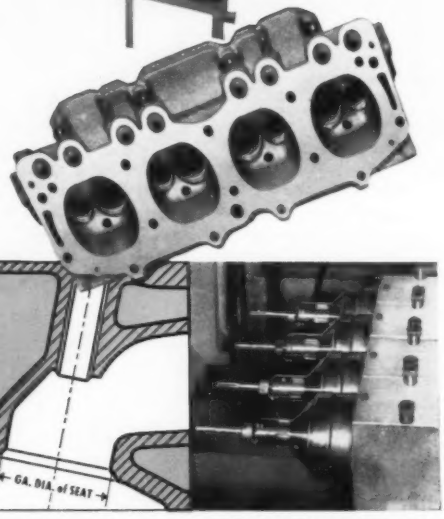
BARNES 5-STATION PROGRESS-THRU VALVE FINISHING MACHINE. Handles two different width V-8 cylinder heads. Finish faces and bores two exhaust and two intake valve seats and stem holes at each working station. An interchangeable guide rail is used for smaller head, .110" narrower in width. Gross production rate is 122 pieces per hour.

Exclusive W. F. & JOHN BARNES Development Eliminates Reaming, Cuts Finishing Cost

More and more manufacturers of internal combustion engines are today profitably using W. F. and John Barnes machines to cut costs in processing valve seats and stem holes. The accuracy of this new, exclusive tooling method reduces machining costs by eliminating the need for reaming or other final finishing operations. Guide holes are finish-bored and valve seats finish-faced simultaneously in a single pass. Concentricity of the valve stem hole and face is held within .0005" total indicator reading.

Basic Method Can Be Easily Applied To Either Small or Large Jobs

The efficiency of this new machining method can now be economically applied to all types of valve jobs — small as well as large cylinder heads or blocks. Either fully automatic or semi-automatic machines can be provided to suit your production needs. As illustrated, single machines can also be designed to efficiently handle more than one size workpiece which effects additional savings in floor space and equipment costs.



CONCENTRICITY .0005" T.I.R.
Fine finish to precision tolerances eliminates reaming operations. Concentricity of guide hole and gauge diameter of seat is held to .0005" T.I.R.

DUAL-TYPE PRECISION SPINDLES
Dual-type precision spindles equipped with facing and gun boring tools. A second 4-spindle head on machine above completes valve operations on V-8 cylinder heads.

Builders of Better Machines Since 1872

W. F. & JOHN BARNES

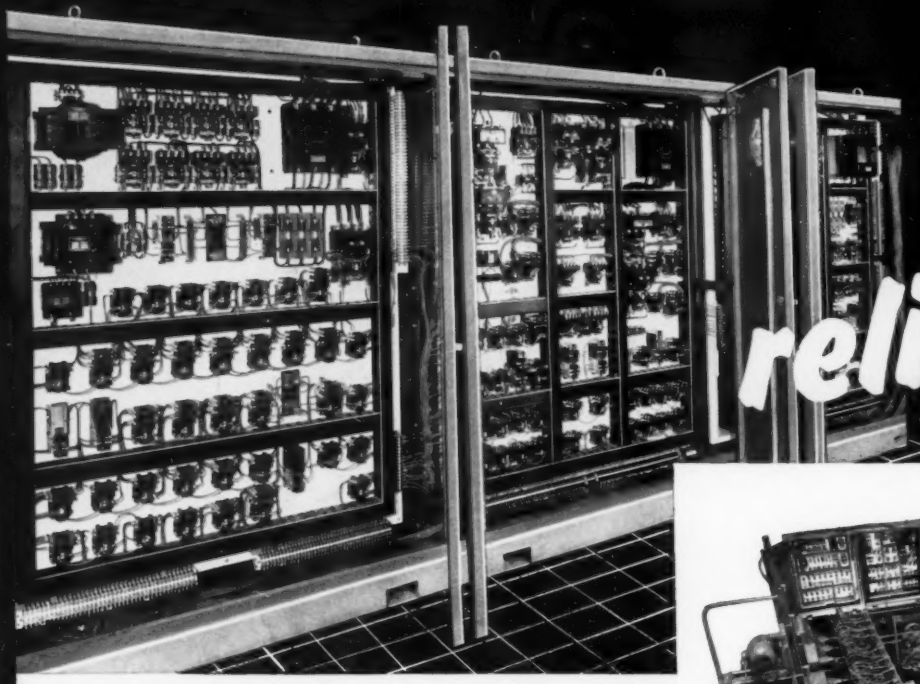
ASK FOR AN ANALYSIS OF YOUR MACHINING METHODS — Ask a Barnes engineer to work with you when planning new or improved machining methods. His experience with, and knowledge of, proven cost-cutting methods can help you save time and money. *Write for New Catalog* illustrating how Barnes 6-point machine building service saves you time, and eliminates divided responsibility.

W. F. & JOHN BARNES COMPANY

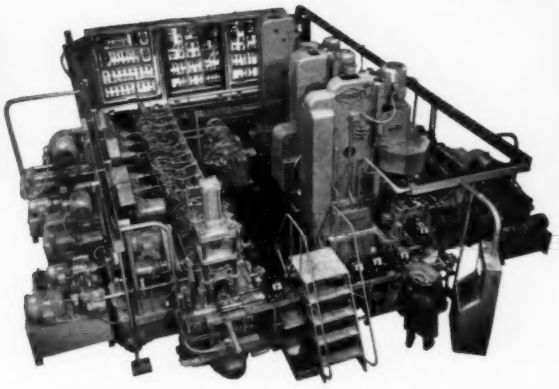
402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress Thru Transfer-Type Machines

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**



preferred . . . because it is reliable!



This Baker Automatic Transfer Machine is equipped with a special Allen-Bradley control panel, assembled from standard components listed in the latest A-B Handy Catalog.

ALLEN-BRADLEY MOTOR CONTROL QUALITY

Twenty-six machining operations are performed automatically on this huge transfer machine. To keep this machine operating continuously—to avoid costly production shutdowns—Baker Brothers, Inc., selected Allen-Bradley quality motor control—the simple control that is good for millions of trouble free operations.

The recognized reliability of Allen-Bradley motor starters and relays is the result of their simple design. Having only *one* moving part, wear and consequent trouble are reduced to the minimum. The double break, silver alloy contacts . . . standard throughout the Allen-Bradley line . . . never need attention. They are always in perfect operating condition.

Simplicity of design and silver alloy contacts are features of all Allen-Bradley control auxiliaries—they are similarly trouble free. Therefore, standardize on the Allen-Bradley line of *quality* motor starters, relays, push buttons, limit switches, and other accessories. You cannot possibly make a mistake!

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

BULLETIN 802T
Oiltight
Limit Switch

Has completely sealed operating head and switch body. This adjustable roller lever type saves installation time.

BULLETIN 700
Solenoid Relay

Universal type relay has contacts that can be connected for either "normally open" or "normally closed" operation.

BULLETIN 709
Solenoid
Starter
(Size 1)

Popular across-the-line starter with accurate and reliable overload relays. 8 Sizes to 300 hp, 220 v; 600 hp, 440-550 v.

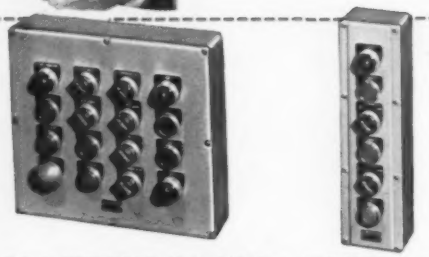
7-58-R

A-B QUALITY

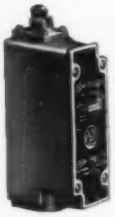
Not only the Motor Starters, but the Accessories must be "Quality," too!

we specify ALLEN-BRADLEY ...all the way

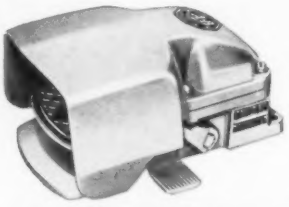
"Trouble" that shows up in a motor starter is often traced to a faulty operating auxiliary—such as a limit switch or even a push button station. Allen-Bradley builds the same high quality into its many accessories as it does into its motor starters—to give you millions of trouble free operations. They are also tested as thoroughly. Contacts are usually double break and always are of a silver alloy, which means they remain in perfect operating condition. It will pay you, too, to specify Allen-Bradley *Quality* control—"all the way!"



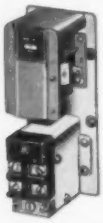
Bulletin 800T Oiltight Control Stations. Available in from one to sixteen units, in die cast aluminum enclosures.



Bulletin 802 Precision Limit Switch, with oiltight head and body.

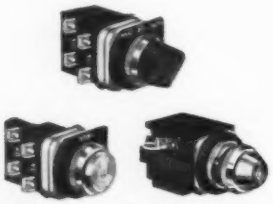


Bulletin 805 Foot Switch. In rugged die cast enclosure for the toughest service.



Bulletin 849 Pneumatic Timer. Reliable and accurate.

Bulletin 837 Temperature Control with snap action, precision switch.



Bulletin 800T Oiltight Push Button, Selector Switch, and Press-to-Test Pilot Light.

Bulletin 800 Standard Duty Push Button. One, two, and three buttons; also as selector switch.

Bulletin 836 Pressure Control in NEMA 4 watertight enclosure.

7-58-R

Allen-Bradley Co.
1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY
QUALITY
MOTOR CONTROL

Economy-priced Royal Drills are multi-purpose machines. Built to handle light drilling on a production basis, they are ideal for utility operations as well. And, because they are CINCINNATI-quality *metalworking* drills, they maintain accuracy longer. That's why, in the long run, *they cost less than the lowest price drill.*

CINCINNATI Royal Drills are built in 16″ and 18″ sizes in bench, floor and multiple spindle models. This $128.00 bench model includes vee belt, belt guard, manual control (single phase) with overload protection, motor mount.

Call in your CL&T Dealer Or, write us direct.

Among CINCINNATI quality features are:

- Complete electrical controls built into the head.
- Convenient, positive depth stop.
- Tilting motor bracket for rapid speed changing.
- 6-spline spindle mounted in 4 precision bearings.
- 5 spindle speeds.
- ⅜″ drilling capacity in C.I.
- Spacious tables and bases.

Improved Machining Through Research

CINCINNATI LATHE AND TOOL CO.

3207 Disney Street • Cincinnati 9, Ohio

"TRAY-TOP" Lathes / "CINCINNATI" Drilling Machines / "SPIROPOINT" Drill Sharpeners

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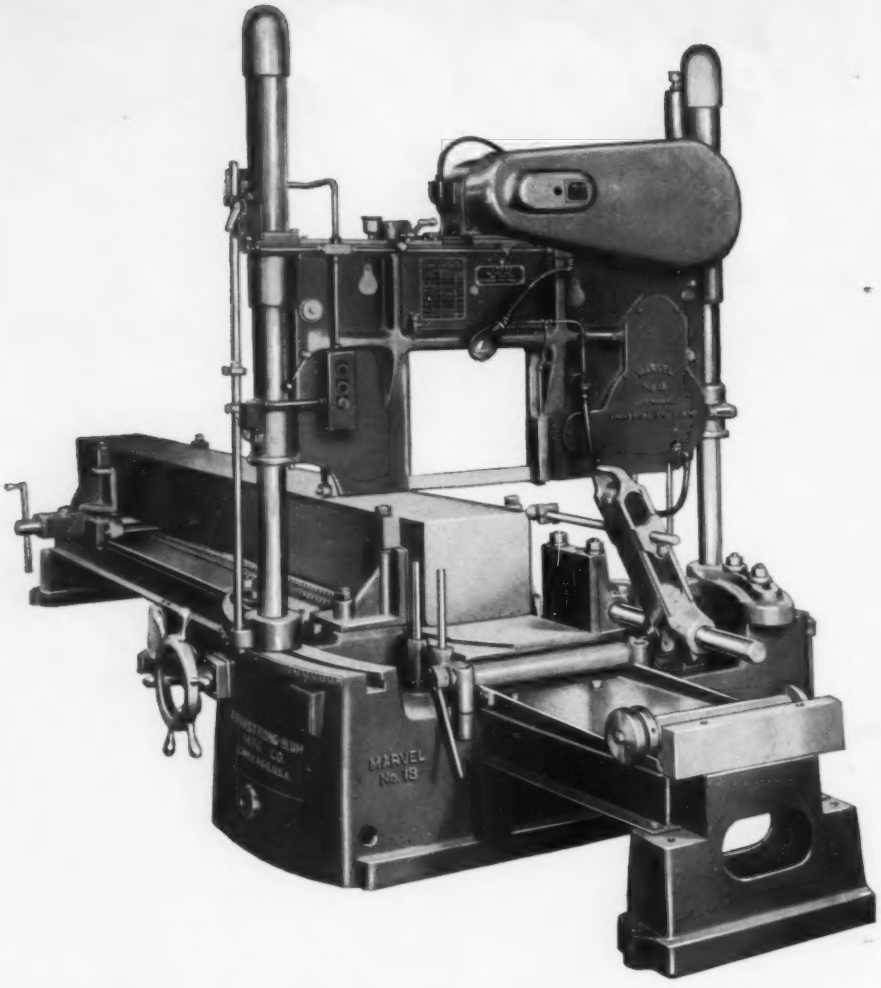

No Job too big or too tough . . .

for MARVEL "*Giant*" Hack Saws

These giant MARVEL Hydraulic Hack Saws (No. 18, Capacity 18" x 18"; and No. 24, Capacity 24" x 24") were *basically* designed for rapid and economical cut-off of BIG WORK. They are not merely "conventional" designs "stretched" to big capacity. They are truly designed and built with the ruggedness and rigidity necessary to withstand the rough treatment of sawing big work, even though the work is in the "toughest of the tough" alloys.

They are reliably fulfilling the cut-off requirements in innumerable steel mills, forge shops, structural shops, warehouses, and machine shops, with assured low tool cost and minimum kerf loss of steel.

In addition to cutting-off, they are reducing costs by eliminating further machining operations. Heat treated die blocks are being reclaimed for re-sinking by sawing off the worn face; columns, beams, pipe, and tubing are being sawed to *finished*, square ends, eliminating milling; angular sawing is done conveniently by swinging the upper structure on the base, to any angle up to 45 degrees—*without moving the work*.

Contemplating the modern trend toward ever tougher steels and larger sizes, these are the logical sawing machines to buy, not only for today's needs but for tomorrow's as well.

Write for Catalog

Metal Cutting MARVEL SAWS
Better Machines–Better Blades

ARMSTRONG-BLUM MFG. CO. 5700 West Bloomingdale Avenue • Chicago 39, U.S.A.

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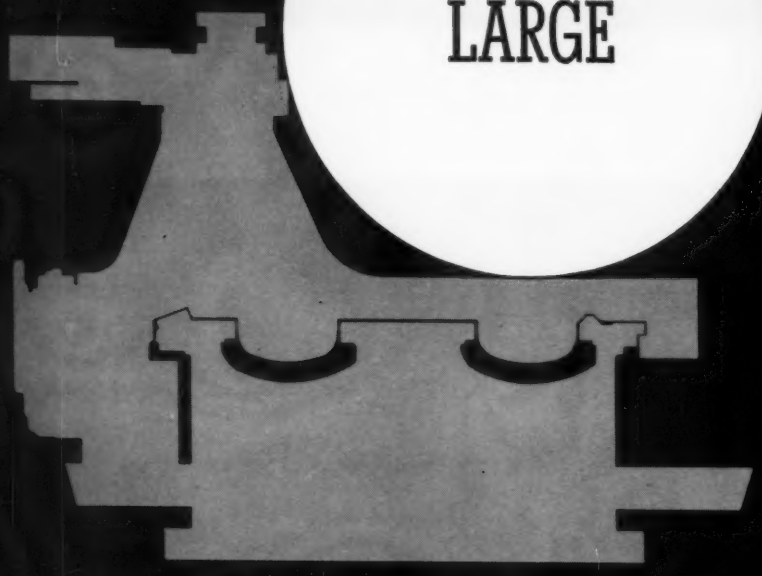
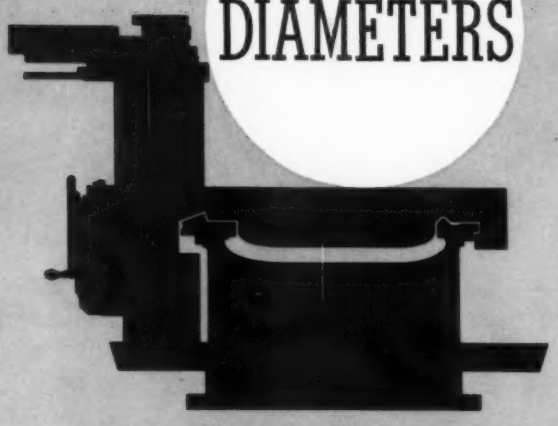
TURNING

LARGE

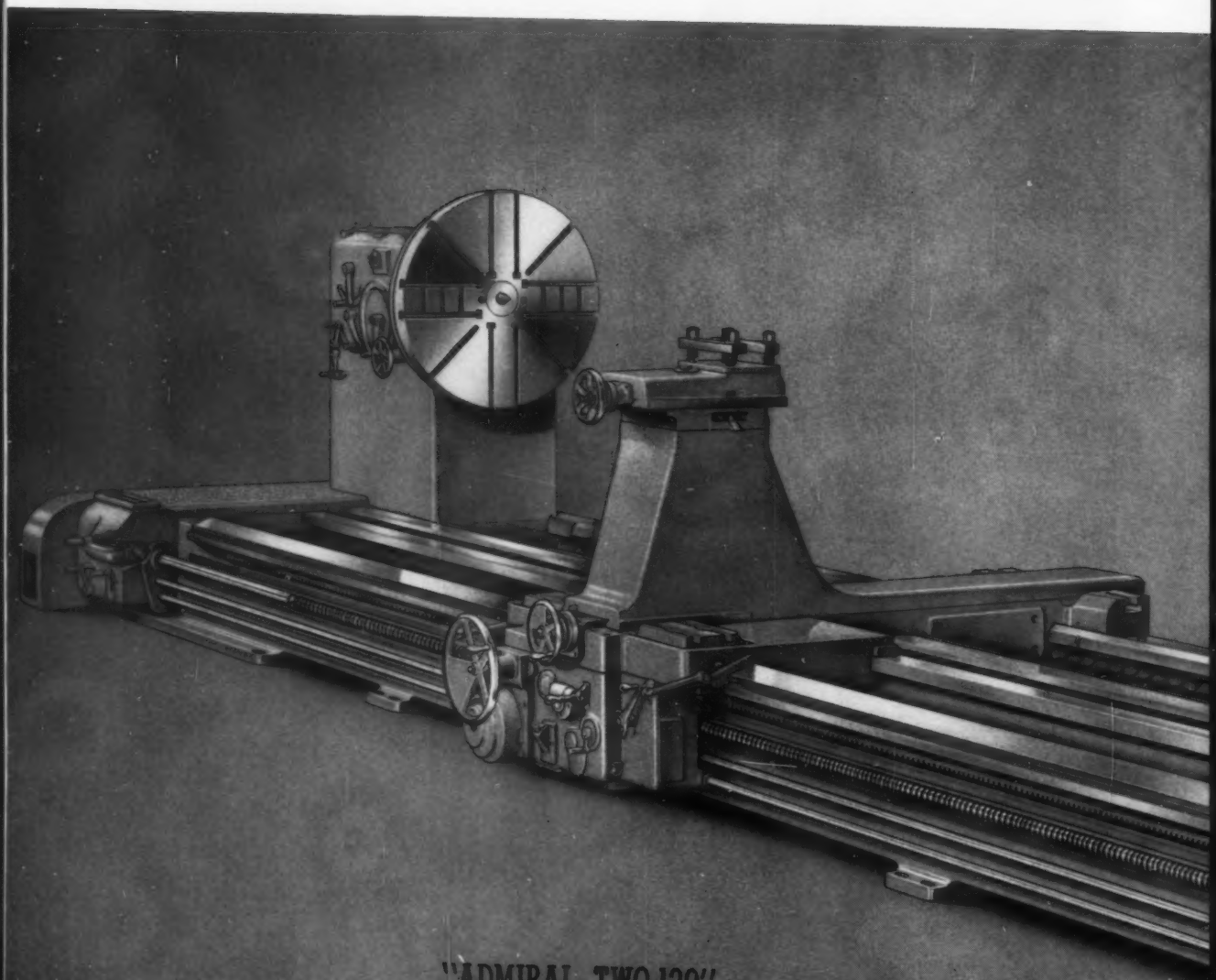


DIAMETERS



On two new LeBlonds

TWO NEW LEBLONDS



"ADMIRAL TWO-120"

Double-bed construction, two beds integrally cast in parallel. Currently designed to swing up to 120". Center distance as required.

for turning large diameters

GENERAL ONE-75"
Outside bed. Swings up to 75".

Missile bodies and other large cylindrical, tubular and fabricated parts . . .

A new class of LeBlond lathes is born—big swing with relatively light horsepower (up to 50 hp). You buy only as much power as your jobs require.

Two new wide bed designs assure that cutting force is properly absorbed into the bed. In addition, you get famous LeBlond rigidity, stamina and convenience, throughout. Two basic models are available, with whatever variations your work may require.

Tracing is available on both machines—Hydra-Trace, two-way duplicating attachment or our new 90° tracer.

Tell us about your large diameter turning jobs. LeBlond engineers are available to work with you in adapting these basic lathe designs to any turning problem you may have. Write us today for complete information.

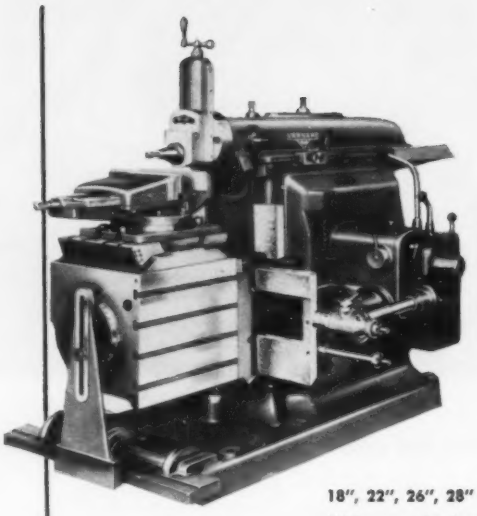
. . . cut with confidence

LE BLOND of Cincinnati

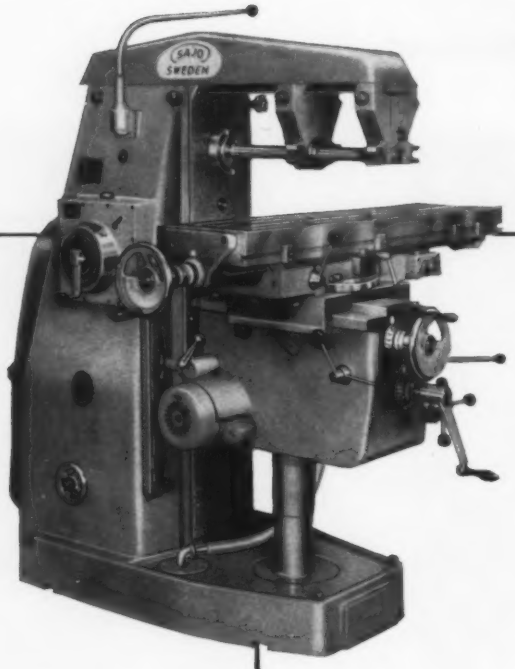
The R. K. LeBlond Machine Tool Company
Cincinnati 8, Ohio

World's Largest Builder of A Complete Line of Lathes for More Than 71 Years

SUCCESS STORY IN SHAPERS AND MILLERS



18", 22", 26", 28" stroke.
With power feeds and power rapid traverse.
Automatic forced lubrication.



7½ HP spindle motor.
3-direction power rapid traverse.
16 spindle speeds, 39-1500 RPM.
50 NMT spindle.
12 Table feeds 33.5" long.travel, 10" cross, 18" vert.

Ask any operator . . . any production expert . . . Swedish craftsmanship as exemplified by SAJO Millers and VMA Shapers pays off with utmost accuracy, dependability, and long economical life. Built to U.S. Standards.

SAJO No. 2 Millers are attractively priced and available in 3 models . . . Model 54, Standard Duty, *All Geared* Millers in Plain, Universal or Vertical types. Model 53, a Light Duty *All Geared* Miller. Model 48, a Light Duty Utility Miller.

VMA Shapers are available as Heavy Duty Model ES and Standard Duty Model EV . . . Model EV Shapers have 14", 18", 22" or 24" stroke. Model ES Shapers have 18", 22", 26" or 28" stroke. Model ES also available as Universal Shapers.

Write for literature and references in your area. Other SAJO products: 10" Universal Dividing Head, Rotary Table, Vise, Hydraulic Power Hacksaw.

austin

INDUSTRIAL CORPORATION

76-E MAMARONECK AVENUE • WHITE PLAINS, NEW YORK

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Helixform*—a new method for bevel gear production!

The new No. 112 Hypoid Helixform Gear Finisher assures improved quality and increased production on spiral bevel and hypoid non-generated ring gears up to 10½" in diameter, and 2½ DP such as employed in passenger car axles.

The Helixform Cutting Method used on this machine offers these advantages:

Conjugate tooth surfaces, minimized gear development, complete control of tooth bearing, and greater adjustability in final assembly.

We will be glad to send a bulletin giving further details on request. Ask for literature on the No. 112 Hypoid Helixform Gear Finisher and the companion No. 112 Hypoid Gear Rougher. Write for it today.

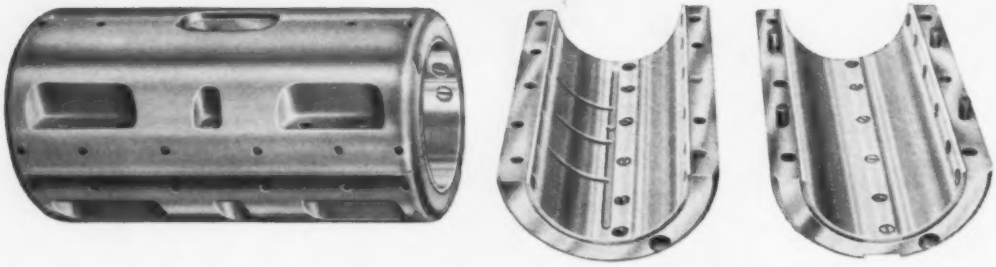
*Trade-Mark

GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

Novel Design provides *Astonishing Bearing Life*

The life of the HILL front spindle bearing on HILL horizontal spindle hydraulic surface grinders is truly astonishing. This bearing has been an *exclusive* HILL feature for more than 15 years. The necessity of replacement, under constant use, is practically unknown.



The front spindle bearing on HILL horizontal spindle hydraulic surface grinders was engineered by the HILL ACME COMPANY and has proven in the field to operate indefinitely. An alloy bronze bushing is fastened to a semi-steel casting with brass screws. The bronze bushing is undercut lengthwise in four equidistant locations on the outside diameter to allow for spindle expansion. (Darker areas in photo show undercut sections.) A perfect bearing surface is established in the I.D. of the bronze directly opposite the undercut sections. Oil is forced into specially designed concave relief areas which act as oil wedges assuring long bearing life. Hardened dowel pins guide the two halves together to their original position. The bottom half of the bearing has an oil return slot shown at the edge of the half section on the outside diameter. Note that there are NO oil grooves in this bottom half or in the quarter half of the top section. The shaft rotation spreads the oil film from the oil distribution grooves to the perfect bearing surfaces. Any additional oil grooves would act as scrapers and be detrimental to the oil film formed around the spindle.

This is just one of the many exclusive construction features that result in the longer life and permanent accuracy of HILL heavy duty surface grinders. Detailed literature on these high-precision machine tools is now available.

24" x 24" x 72" HILL horizontal spindle surface grinder grinding blanking dies to extremely close tolerances. Also built in Vertical Spindle design.

THE HILL ACME COMPANY

HILL DIVISION . . . . . **ESTABLISHED 1882**

1201 West 65th Street • **Cleveland 2, Ohio**

HILL ACME TOOLS FOR INDUSTRY

"HILL" GRINDING & POLISHING MACHINES • HYDRAULIC SURFACE GRINDERS • ALSO MANUFACTURERS OF "ACME" FORGING • THREADING • TAPPING MACHINES • "CANTON" ALLIGATOR SHEARS • BILLET SHEARS • "CLEVELAND" KNIVES • SHEAR BLADES

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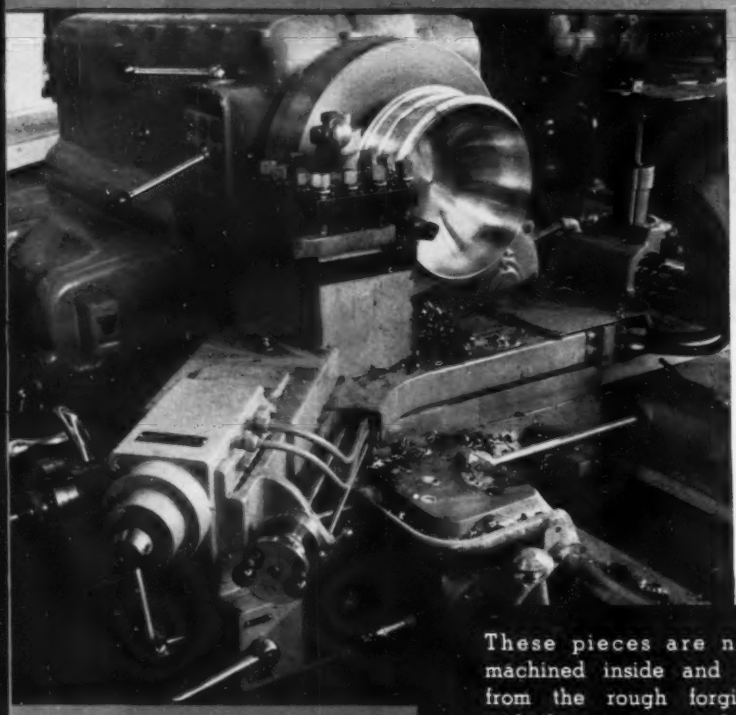
Rheem solves a "toughie"

and increases production *three hundred per cent*

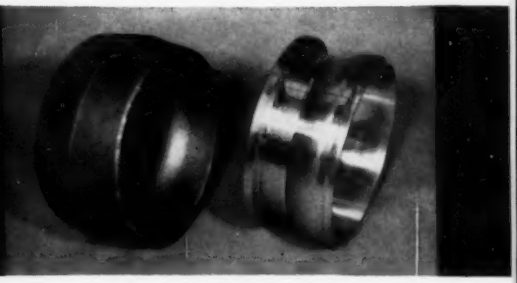


Machining the various contours of these guided missile components with the accuracy and finish required was a problem that Rheem Mfg. Co., Aircraft Division at Downey, California, had to lick.

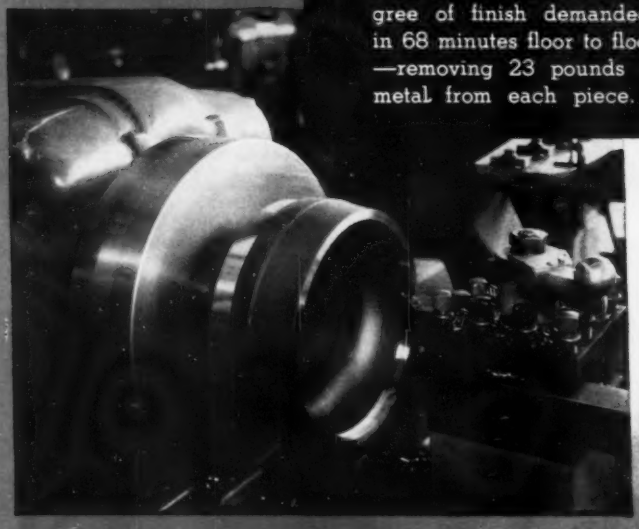
The answer . . .

"AMERICAN"

HYDRAULIC DUPLICATING LATHES



These pieces are now machined inside and out from the rough forging, with the accuracy and degree of finish demanded, in 68 minutes floor to floor —removing 23 pounds of metal from each piece.



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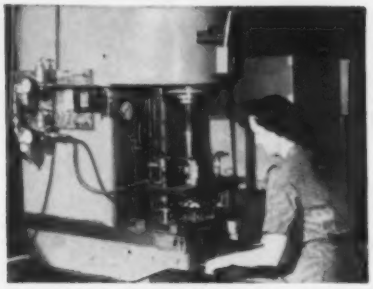
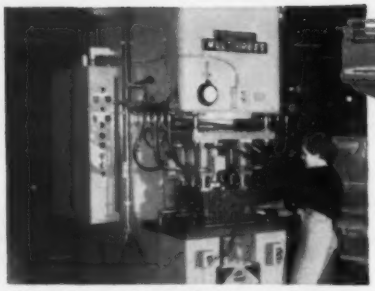
LATHES AND RADIAL DRILLS

Which of these MULTIPRESS ideas will save you money...NOW?



Toy maker forms 1000 parts per hour . . . 8-ton Multipress forms metal toys faster, at less cost for Mattel, Inc.

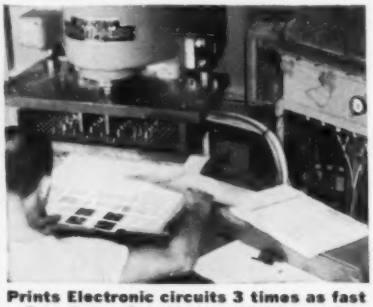


Motorola speeds production...with 100-ton Multipress that precision-punches up to 450 holes at a time in plastic TV chassis bases.

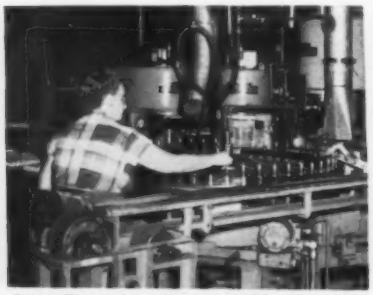
Dormeyer triples production of food mixer parts . . cuts scrap loss, too, with 8-ton Denison Multipress—12-station index table.

Waterman boosts output 800% with 1-ton Multipress that "angles" precision C/C pen parts fast, at low cost.

Cuts cost 73% on sub-assembly of specialty products at George S. Thompson Corp with 4-ton Multipress. Savings—11¢ per unit.



Prints Electronic circuits 3 times as fast at Barry Process Co. with 4-ton Multipress. Controlled timing and pressure assure uniform carbon ink deposit on each printed resistor.



Auto-lite automates assembly of over 150 different types of spark plugs with a battery of 3 Multipresses operating around a 48-station index table.

Production up 33% at Cleveland Graphite Bronze—where 25-ton Multipress compresses soft carbon cores at the rate of 100 per hour.

Trimming rubber flash twice as fast... 4-ton Multipress with 6-station index table trims flash from 2400 molded rubber parts per hour. Old method called for 3 operations.

Time and money savings like these are only a few of hundreds that Denison Multipress can help you make in keeping ahead of competition today.

But modern competition means more than simply faster production. That's why *Multipress plus-benefits* are so *important*.

Multipress on your job can mean larger tool and die life . . . less scrap . . . higher product quality . . . minimum maintenance . . . extra operator safety. *Multipress can give you the competitive edge.*

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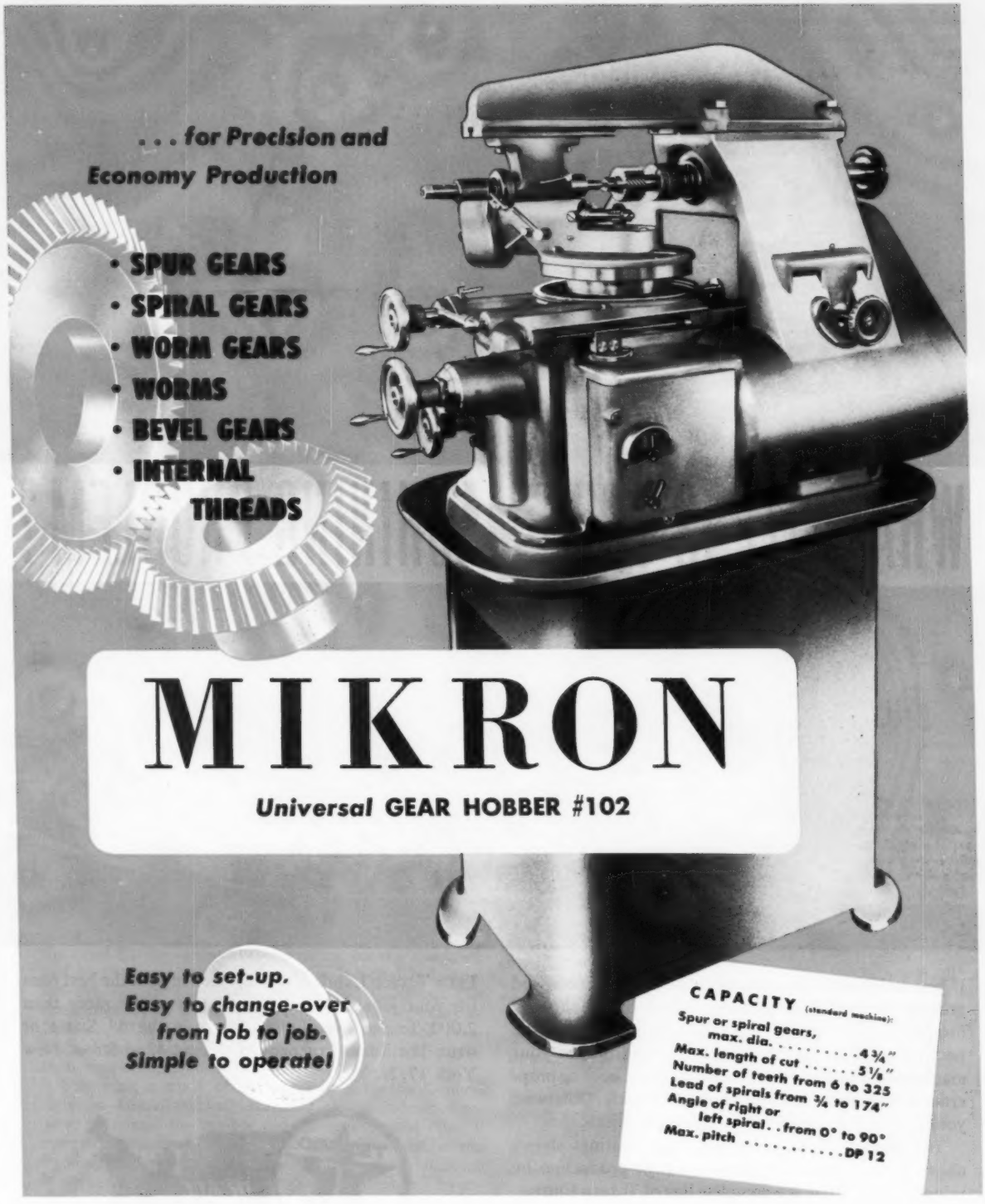
HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS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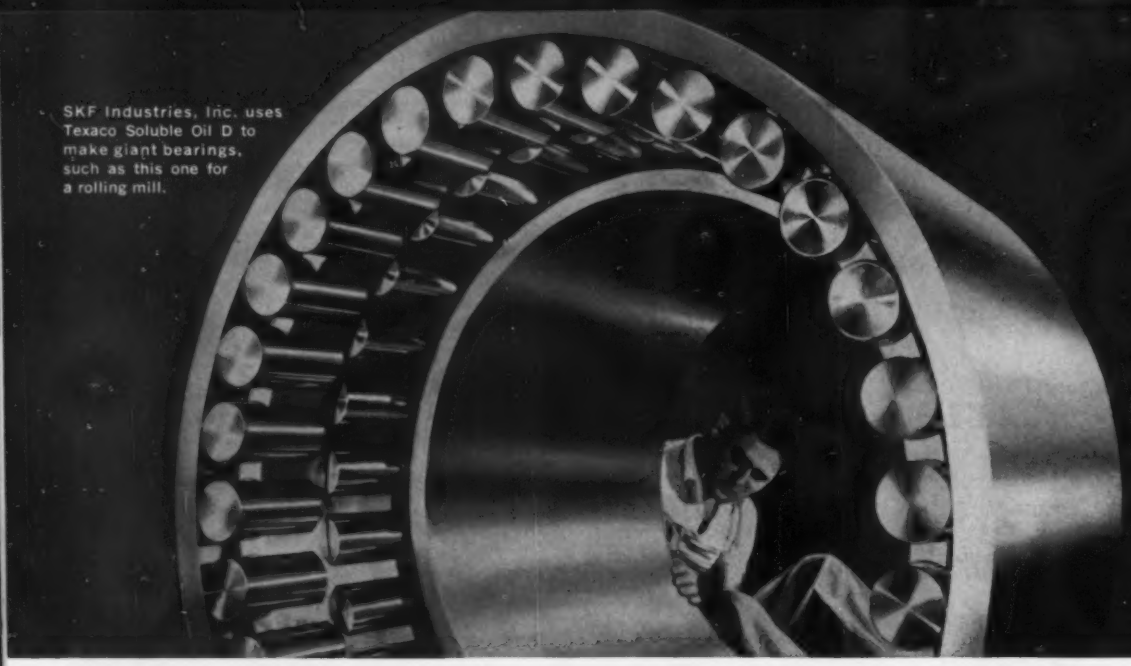
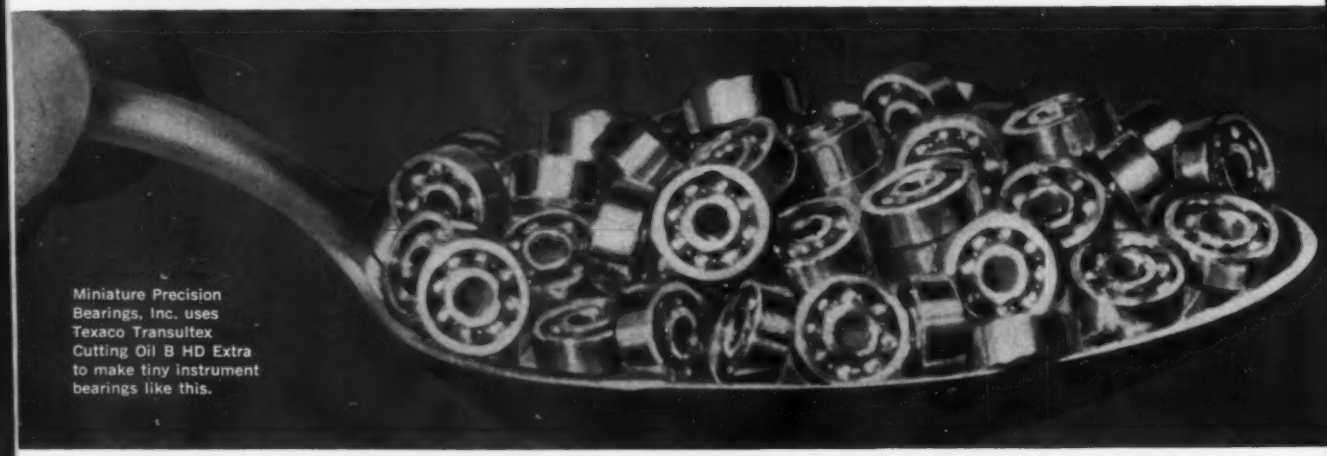


SKF Industries, Inc. uses Texaco Soluble Oil D to make giant bearings, such as this one for a rolling mill.

WHAT SIZE IS YOUR MACHINING PROBLEM?



Miniature Precision Bearings, Inc. uses Texaco Transultex Cutting Oil B HD Extra to make tiny instrument bearings like this.

If you make anti-friction bearings of any size, you need grinding fluids that prevent rust and produce uniformly fine finishes. These fluids must also take into account the bearing material and the operating condition of your machines. They must have specific stability, cooling properties and ability to settle grinding dirt quickly. Otherwise your production drops and the number of rejects rises.

The makers of the small and large bearings shown above get fine bearing finishes and high production by using Texaco. There is a complete line of Texaco Cutting, Grinding and Soluble Oils to help improve machining on every job.

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LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

- Defense Shifts Release Tools
- Plant Disposal Premature?
- Emergency Planning Approved
- About Government Plants, Equipment
- Missile Machining Research

Keeping up with Washington

Loring F. Overman

Changes in the military pattern in process for several months, and touched off in earnest by Sputniks, Explorers, and Vanguards, have involved defense plants and production equipment in a number of important discussions and directives.

Defense Shifts Release Tools

One of the several projects promises to combine two objectives. Some 13,000 machine tools and items of related government-owned equipment now considered surplus will be utilized and, at the same time, their disposal will help alleviate a shortage of the mechanically skilled by providing a means of training youthful hands.

Adoption of the program would channel large numbers of surplus lathes, milling, grinding, and drilling machines to junior and senior high schools, technical schools, colleges, and universities. The donating of surplus government property to schools was inaugurated in 1919; was stepped up in 1946, and now would be expanded. Distribution, after a survey of requirements, will be arranged through the Business and Defense Services Administration with the assistance of the National Machine Tool Builders Association, Metal Cutting Tool Institute, National Tool and Die Manufacturers Association, American Machine Tool Distributors Association, Machinery Dealers National Association, and the Industrial Heating Equipment Association.

Plant Disposal Premature?

Advent of the missile age does not completely nullify the need for conventional weapons, or for the machines and equipment to fashion them, the National Industrial Reserve Review Committee has warned Congress. The committee, in its tenth annual report to the Secretary of Defense, observed that "new weapons, just as new commercial products, never become perfected as rapidly as their supporters predict."

Following a study of data presented by the General Services Administration, custodian of the industrial reserve program, the review committee observed "that a reserve of machine tools and product equipment for use by defense-supporting industries in time of mobilization is necessary." The committee reported a tendency to underrate the mobilization value of the plant and equipment reserve, allowing premature dismantling and removal.

Emergency Planning Approved

"Production Planning with Industry for National Emergency of Mobilization" is the title of a basic policy Directive No. 4005.13 issued by the Department of Defense. The directive covers two possibilities—general war, accompanied by severe damage to the industrial base, and conflict short of war, with undamaged facilities.

As pertaining to general war, the directive outlines precautions to be taken to insure continued production of a highly selective group of essential items or components; production planning to minimize interrupted deliveries, during a post-attack period, of items in process in surviving plants; and maintenance of dispersal facilities or alternate sources of supply. For limited warfare, the directive outlines five requirements for anticipating probable needs in combat, for subcontracting and dispersal of facilities, and for limiting the production rate to that required to sustain military activity at the force level designated by the Secretary of Defense.

The directive requires the Secretary of Defense to specify the forces to be supported in connection with planning under the directive. It also requires that production planning programs comply with the new policy within 120 days of March 27, 1958. Military services are forbidden to undertake programs inconsistent with the new policy. All exceptions must be cleared with the Secretary of Defense.

About Government-Owned Plants, Equipment

A companion DOD Directive No. 4004.14 applies the foregoing policy to planning for government-owned industrial facilities and production equipment. Under this directive, major reliance for defense production is placed on privately owned facilities and equipment; secondarily, on privately owned facilities employing government-owned production equipment not available in the civilian economy; and, finally, on government-owned plants and equipment.

The directive bans maintenance or retention of government plant or equipment in excess of that determined in advance to be necessary and makes it plain that the use of "privately owned facilities will not be discontinued to justify continuation of government-owned facilities." The ban does not include arsenals and similar installations . . . "those government-owned overhaul, repair and production facilities which, because of their integrated logistic support, are considered organic to the military, or must be under military command in an emergency."

Missile Machining Research

How to speed up the machining of the ultra-hard metals required in missile building is now a subject of research. Air Force and Lockheed Aircraft Co. are the experimenters. Air Materiel Command hopes the studies will reveal how alloys with tensile and yield strengths of more than 200,000 pounds per square inch can be machined at high rates of speed, with reasonable tool life but without impairing product strength and quality.

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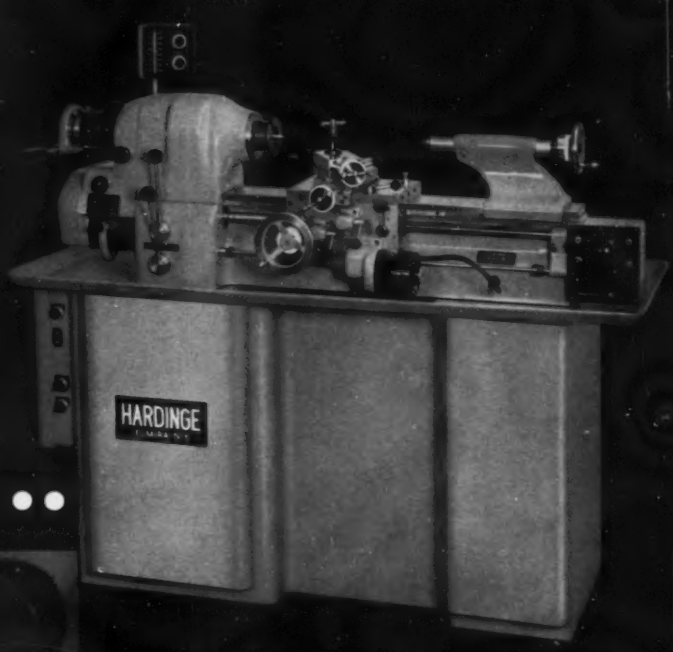

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. . . **HARDINGE** developed these fast setting easy reading **black and white dials** — they assure maximum accuracy with high production.

Pioneered with the Hardinge High Speed Precision Tool Room Lathe model HLV shown here — **Hardinge black and white dials** are now standard equipment at **no extra cost** on all of our tool room and production machines.

Invest in Hardinge equipment for product improvement and increased production. Ask for bulletin on our tool room and production machines.

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ELMIRA, N. Y.

Machinery
JUNE 1958

Talk About Splitting Hairs!

IN YEARS not far in the past it was customary to emphasize the accuracy of precision operations in machine shops by pointing out that parts had to be made to specified dimensions within a few ten-thousandths of an inch. Then, to dramatize such accuracy, it was generally mentioned that the average human hair was only 0.003 inch thick. Hairs had to be split in endless operations.

Today such a degree of accuracy is no longer startling even to the layman. When it comes to guidance systems for rockets and intercontinental missiles, tolerances in the order of "ten-thousandths" are wholly inadequate for certain parts. Tolerances of that magnitude could result in the final terminus of the projectile miles away from the intended destination.

Millionths of an inch are, therefore, the tolerances specified on certain operations in shops that produce guidance systems and other electronic devices. In one shop recently visited by the Editor, a 1/2-inch diameter leadscrew 7 inches long with forty threads per inch must be produced with a cumulative lead error of less than twelve-millionths of an inch. The screw must be straight within the same tolerance. An involute cam must actually be made with its profile true within six-millionths of an inch.

Such accuracy, not long ago, would have been considered beyond the realm of possibility. Today, it is an established fact that stresses the necessity of early action in establishing one standard inch for the three that are now standards in the inch-using countries.

High praise is due the ingenuity of production personnel in shops that manufacture parts within "millionth" tolerances, to the builders of the machines on which such work is turned out, and to the producers of the equipment that can check parts easily to such a high degree of accuracy. The dreams of machine shop visionaries of days gone by have come true.

One-millionth of an inch means dividing a hair into three thousand equal parts. Talk about splitting hairs!

Charles O. Herb

EDITOR

"Maybe there's a steel to do it better . . . ask Ryerson!"

If there is a better steel for your operation, Ryerson can tell you. A Ryerson specialist will assist you in solving the problems of steel application and fabrication, too.

Ryerson strategically located plants carry large stocks to meet virtually every steel need. That's why the Ryerson specialist will suggest only the best steel for the job. He can offer you facilities and experience to help with design problems.

And as the Ryerson specialist works with you on problems of steel selection, he will also develop a plan for efficient delivery. This means a smoothly flowing production line while inventory investment is kept at a minimum.

There's a steel specialist at your nearby Ryerson plant ready to work with you. So—when you have a question of the best and most economical steel to use, ask Ryerson.

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For more information fill in page number on Inquiry Card, on page 179

Courtesy of Columbus Coated Fabrics Corporation

R. P. HOOKER, Products Engineer
Arvin Industries, Inc., Columbus, Ind.

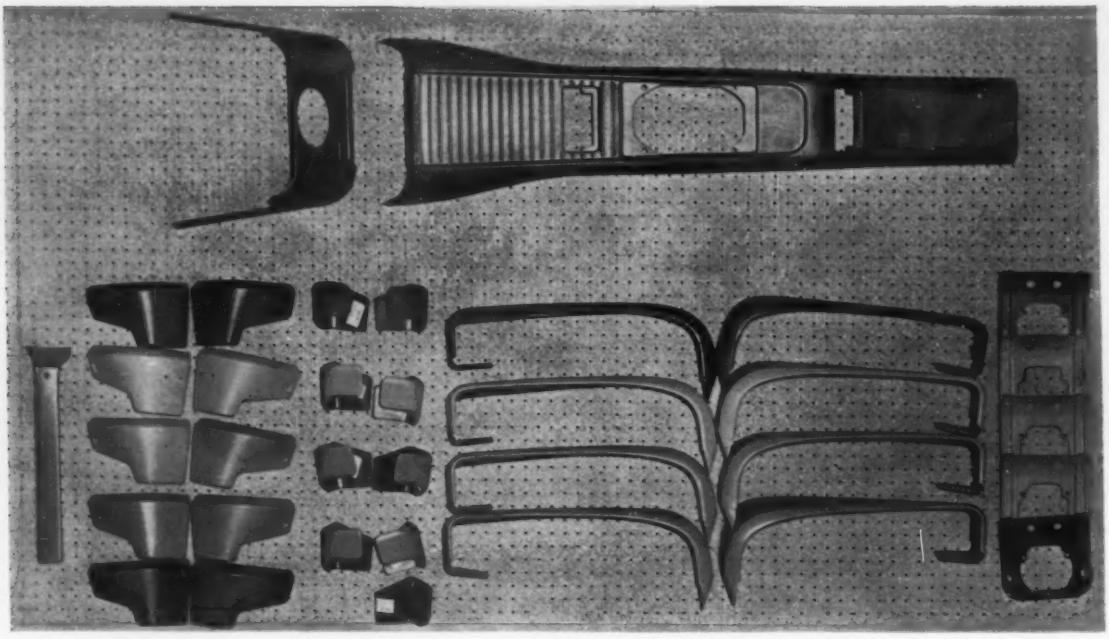
VINYL-METAL LAMINATED SHEET offers the product designer a prefinished material that is strong, decorative, and easy to fabricate. The laminates can be deep-drawn, sheared, crimped, bent, punched, and drilled without injury to the bond or the vinyl, and with virtually the same ease as though the material were ordinary sheet metal.

The vinyl currently in use ranges in thickness from 0.004 to 0.020 inch. It is received by the laminator in rolls—embossed and printed in wood, leather, and marble grain; in cloth and basket-weave textures; and in metallized prints. Steel, aluminum, or magnesium, 0.015 to 0.060 inch thick, forms the backing. So tight is the bond between the metal and the vinyl that the material can be processed with standard metalworking tools and fixtures without damaging the finish. The laminates show high resistance to abrasion, rust, chemicals, and heat (up to 275 degrees F.).

Applications for the laminate are broad. Among its present users are fabricators of luggage, furniture tops, appliance cases, camera cases, radio cases, business machine cases, doors, shelving, seat backs, thermos jugs, and automobile interior trim parts. Proposed uses seem limitless: advertising signs and displays, boat decks, automobile roof panels and fenders, trailer bodies, partitions, railroad passenger cars, lawn furniture, sinks, and roofing—to mention just a few. Entire walls of the product, incorporating electric heating elements, already exist. Conceivably, this application could make present room-heating methods obsolete.

In many instances, final costs may be less for the laminate when compared with the practice of fabricating a part of metal and subsequently finishing it by spraying or plating. To begin with, the labor involved in bonding vinyl to flat sheets of metal in a continuous process is much less than the cost of painting or plating stamped or drawn individual metal pieces. And when a vinyl is used, there need be no investment in ovens, spray booths, conveyors, spray guns, or strip tanks; nor is there any need to inspect the finished work for tear drops, sags, or streaks. The backing can be of lighter gage than a comparable all-metal sheet because of the bulk supplied by the vinyl—further savings for the fabricator.

One of the leading laminators in this mushrooming field is Arvin Industries, Inc., Columbus, Ind. "Arvinyl" laminates are already featured in many items in this company's lines of radios, heaters, and fans. Arvin also has long been identified as an important automobile parts supplier, and its laminates can be found in the interiors of several 1958 models. Typical of these are the parts shown on the display board, Fig. 1. On the upper part of the board are front and rear console panels which cover the drive-shaft hump in the floor. Beneath it, from left to right are a pillar cover, front and rear seat corners, right and left seat side shields, and console covers.



Preparing the Backing

Since the bond between the metal and the adhesive is mechanical, strength is obtained by etching the surface of the metal so that it is porous rather than smooth. To prepare them, incoming sheets (18 to 48 inches wide, and 55 to 144 inches long) traverse a five-stage line. The first stage is an alkaline hot spray; the second, a hot spray rinse. In the third stage, the surface is roughened (made porous) by phosphatizing. The fourth stage, a cold spray rinse, is followed by a chromic-acid rinse in the fifth stage. The latter seals the surfaces and neutralizes any alkalinity carried over from previous stages. Alkaline in the surface weakens the bond.

As the sheets leave the fifth stage, they enter an oven. There, the remaining moisture quickly evaporates, and any streaking by the chromic acid is checked.

Sheets are now conveyed to the laminating line, where the initial processing consists of roller-coating the bonding surface with a thermoplastic adhesive, as can be seen in Fig. 2. Film thickness is 0.0025 to 0.005 inch. To obtain an even film, the viscosity of the adhesive is kept within close lim-

Fig. 1. (Above) Laminates like these can be found in the interiors of 1958 automobiles. They are made in a variety of colors to fit the car's decor.

Fig. 2. (Left) Processing along the laminating line starts with roller-coating one side of the backing with adhesive.

Fig. 3. The vinyl is applied to the sheet immediately upon emerging from the oven while the adhesive film is still at activating temperature.

its, according to the ambient temperature, by the addition of a proper amount of solvent.

Once coated, the sheets are preheated in a forced-air oven. The purpose of the preheat is to evaporate the solvent in the adhesive, thus preventing any explosion in the next oven in the line. Preheat temperature must be carefully controlled. It must be high enough to evaporate the solvent without being so high that the solvent boils in the film. Boiling leaves craters in the film, which later may appear as objectionable indentations in the vinyl surface.

In the second oven, the adhesive is activated, or brought to a semi-liquid state, by raising sheet temperature to about 385 degrees F. The exact temperature will vary, depending on the thickness of the vinyl to be applied. Too low a temperature weakens the bond; too high a temperature causes the adhesive to carbonize, and also causes the vinyl to lose its gloss and grain.

Applying the Vinyl

Immediately upon leaving the second oven, the sheets arrive at the laminating station, where the vinyl is applied, illustrated in Fig. 3. A roll of vinyl can be seen on the top of the stand between the operators. Rolls are purchased in 250-yard lengths, from 18 to 48 inches wide. The material is characterized by its closeness in appearance to cloth or leather. It is pliable, has good tensile strength, and is acid- and water-resistant.

As each sheet comes out of the oven, it meets the vinyl and both advance between two rubber

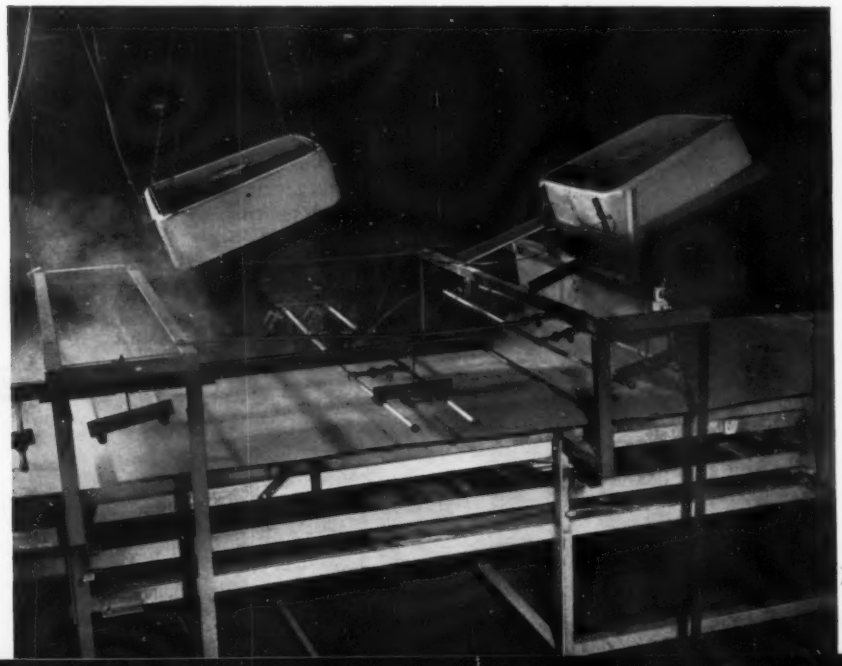
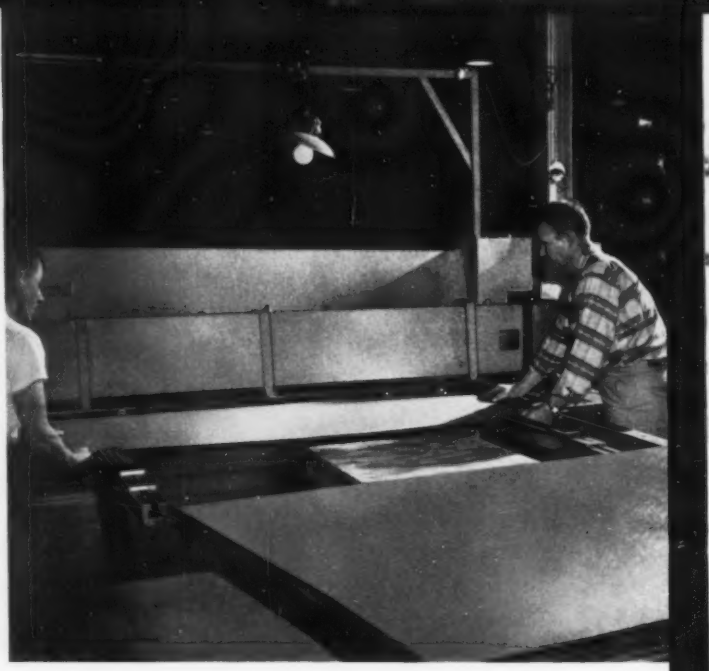


Fig. 4. After a water spray cools the sheets, fans blow off remaining moisture. Laminates can now be stacked.

rolls. The lower roll is a driver, and the upper roll produces the necessary pressure (60 psi). To produce the pressure, the ends of the upper roll are carried in levers which are controlled by air cylinders. Roll hardness and pressure are such that the rolls have a slight "flatting" effect.

In width, the vinyl overlaps the metal backing slightly. The roll pressure during the laminating causes the vinyl to be scored along the edges of the sheet, and the operators are then able to strip off the excess vinyl as it leaves the rolls. Sheets follow each other through the oven with practically no space between them. As a result, vinyl can be applied continuously with very little waste from one sheet to the next.

To set the bond and dry the laminate, the sheet is cooled by passing through a cold-water spray and then receives an air blast beneath the two fans seen in Fig. 4. The cooling also prevents any loss in the embossing in the vinyl when the sheets are next stacked. Laminates having aluminum backing are now ready to be fabricated. For those with steel backing, a fast-drying rust preventive is first roller-painted on the underside.



Drawing Techniques Parallel Usual Methods

Fabricating starts by cutting the laminated sheets to whatever blank size is required for the press operations. Sheets are sheared individually, as in Fig. 5.

Drawing is similar to conventional practice, with just a few qualifications. Vinyl cannot be crowded, but must be allowed to flow freely. Draw beads, used to control the flow of the material into the die, are found more frequently than in ordinary dies. High holding pressures under the bolster are needed—approximately 30 psi more than with steel—and this, in turn, calls for a heavy chromium-steel draw-ring. If the drawing is at an angle, then a pinch-trimmed edge should be incorporated in the design of the die at points of stress, to prevent rupture of the vinyl. This "tear-drop" edge is essential when trimming from the steel out to the vinyl.

Die lubrication is highly important. Mutton tallow, although costly, proves excellent for this purpose. Compounds with a vegetable-oil base are less expensive substitutes and have the necessary fatty quality. Sulphur-base oils attack the vinyl, and must be avoided. Drawing speed is relatively low compared to steel, about 1 foot per minute.

Two typical press operations are illustrated in Figs. 6 and 7. Fig. 6 shows the drawing of the

Fig. 5. (Above) First operation in fabricating the laminates is cutting them to blank size for drawing. Machine is a Niagra power squaring shear.

Fig. 6. (Left) The sheared blanks are drawn on a Bliss straight-side mechanical press. Die design permits sufficient flow of the vinyl to avoid damaging it.

Fig. 7. (Left) Trimming seat side shields on a Hamilton press. "Teardrop" edge provided for in die design prevents rupturing of the vinyl.

Fig. 8. (Below) Synchronizing heat and pressure in a welding time of a fraction of a cycle is the secret behind successful welding of laminates.

central section of a panel for the hump in a sports car floor. Later, the ends of the panel will be bent, and a center opening punched, like the finished piece seen on the display board in Fig. 1. Four different trimming operations on seat side shields for the same car are being performed in the press seen in Fig. 7.

Welded Assemblies Now Practical

Until recently, the single serious restriction on the product designer's use of the laminates has been the inability to resistance-weld clips, brackets, hinges, or other hardware to the steel backing without ruining the vinyl. The problem becomes obvious when it is realized that one side of the steel must be hot enough to melt, while the vinyl itself must not get much above the temperature of boiling water.

The answer has been found in a projection-welding technique employing magnetic force. Projections are used in order to concentrate the heat. By substituting magnetic force for the usual hydraulic or pneumatic force to squeeze the parts together, heat and pressure are precisely synchronized to a fraction of a cycle. Since the vinyl is an insulator, the current does not flow through it, as in ordinary resistance-welding techniques. Instead, it flows through the back of the laminate and the hardware.

Arvin's use of a magnetic-force welder is shown in Fig. 8. Here, tempered steel clips are being projection-welded to the backing of a vinyl-steel laminate forming the front case of a portable radio. The machine was designed and built by the Precision Welder & Flexopress Corporation, and is equipped with Robitron controls. A 150-kva transformer furnishes the current for the welding; and a 50-kva transformer, the magnetic force. The welds show excellent shear strength.

How Do Your Foremen Rate?

ROBLEY D. STEVENS
Management Consultant
Washington, D. C.

SOUND management-employe relations are essential to the economical and efficient operation of any firm. It is possible to get a better day's work from supervisors and employes alike when mutually satisfactory relationships exist. Like job evaluation, a systematic merit-rating plan will provide management with information essential to gain the highest supervisory quality and performance. While a merit-rating plan should not be considered a substitute for intelligent and enlightened personnel relations, it can help foremen improve their efficiency.

The burden of fully utilizing the skills and abilities of all employes falls squarely upon the shoulders of management. If supervisors are inefficient, full utilization of employes is impossible. An increase in personnel turnover arising from today's competition may be minimized by providing high-quality supervision. Good supervisory selection and training are important to every employer, but they must be supported by good supervisory merit rating. All manufacturers, large or small, are concerned with cost; and an improperly selected, trained, and rated supervisor may be costly.

The value of a supervisory merit-rating plan is twofold. First, it gives management a clear picture of which men are below or above par. Also, it affords a factual, non-emotional basis for discussing each supervisor's good and weak points with him for the purpose of improving his work and supervisory performance. Such a plan offers a formal procedure, conducted at regular intervals, to assess the performance, qualifications, progress, and deficiencies of foremen. In most instances, the interval for periodic rating should be twelve months. A supervisory merit-rating plan that fulfills such requirements can turn up supervisory talent that otherwise might not be recognized.

In addition, this type of plan helps to bolster workers' morale. The knowledge that a supervisory merit-rating plan is in effect often relieves the anxiety of workers as to whether or not they may get the recognition they deserve, or that others, less worthy, might get preference. It salves the wounds of disappointed employes by assuring them that they may try again for the next supervisory opening.

Today many firms endeavor to find people within their organizations who can be promoted to the job of foreman whenever a vacancy occurs. They find that this has a definite bearing on the growth and development of supervisors. More and more skilled workers in industry seem to be looking for jobs that offer opportunities for advancing their careers.

Studies by management indicate that the following qualifications are sought in supervisors: leadership, organizing and mechanical ability, technical skill, judgment, initiative, adaptability, self-confidence, and character, as well as physical and mental alertness. The first step in setting up any supervisory merit-rating plan should entail job analysis, which determines what the supervisor does and the requirements for his job. Job analysis provides pertinent information relating to the nature of a specific job.

Often, however, in selecting a foreman, there is some temptation to fill the job without realizing that something more than a foreman is wanted. All supervisory jobs have some common elements. It seems important to recognize that no two supervisory jobs are identical, because in many cases the differences are as important as the similarities. Today, employers are in need of supervisory leadership of the highest caliber. This is an art that may be acquired, developed, and practiced by all who supervise, and it is also a continuing process. A careful consideration of the background and characteristics required for supervisory jobs can eliminate many undesirable persons. The accompanying self-analysis chart can be used by every supervisor. It enables supervisors to determine their own adequacies or inadequacies as an aid to planning future growth.

This self-analysis chart lists in systematic order the responsibilities a supervisor needs, and is an aid to every supervisor who wants to improve himself. The manner in which the duties and responsibilities are performed determines success or failure in carrying out the job. Such tests are meant merely as a guidepost to help one become a better foreman.

SUPERVISORY MERIT-RATING FORM

Date .....

Name ..... **Title** .....

Pay Rate ..... **Department** .....

Yes	No	
		UNDERSTANDING THE ORGANIZATION
		Do You . . . Understand the functions of your job and your department, and how they contribute to the total program of your company?
		Show each employe how his job fits into the over-all picture?
		Know how to determine the lines of your authority and responsibility?
		Determine the number of and types of employes needed?
		Make a logical assignment of your employes based on a clear outline of your authority and responsibility?
		GETTING THE WORK OUT
		Do You . . . Give instructions that are clear, understandable, and specific?
		Review work for progress in meeting your schedules?
		Coordinate the work of your department?
		See that your employes do what is expected of them?
		Emphasize the control of cost?
		Minimize the necessity of overtime work?
		Resolve your production problems immediately?
		PLANNING AND SCHEDULING WORK
		Do You . . . Keep up with the workload?
		Give priorities of work and schedule proper attention?
		Plan for the best use of manpower, space, and equipment?
		Set realistic goals for your employes?
		Allow your employes to participate in setting their own goals?
		Apply work simplification?
		IMPROVING YOUR WORKING METHODS
		Do You . . . Analyze your department operations?
		Evaluate present methods of performance?
		Encourage your employes to produce more efficiently?
		Place employes on phases of operations where they can do effective work?
		Look for better, cheaper, and easier ways of producing?

Yes	No	
		DETERMINING PERFORMANCE REQUIREMENTS
		Do You . . . Decide what is expected from each employe?
		Make a final determination of work requirements based on company needs
		Evaluate objectively each employe's performance based on company requirements?
		DEVELOPING YOUR EMPLOYES
		Do You . . . Select the right person for the right job?
		Help employes make adjustments on new jobs?
		Decide training needs of your employes?
		Suggest employe training to management?
		Discuss career opportunities with employes?
		Develop understudies?
		MAINTAINING A COOPERATIVE WORK FORCE
		Do You . . . See that employes are rewarded for jobs well done?
		Commend the entire group on performance when deserved?
		Transfer and reassign employes for the best use of their skills and experience?
		Have the confidence and loyalty of your employes?
		Maintain effective discipline?
		Keep employes well informed on company policies?
		SELF-IMPROVEMENT
		Do You . . . Recognize your own shortcomings?
		Constantly strive to get along better with people?
		Have a cooperative attitude toward your job and your boss?
		Seek responsibility?
		Keep abreast of new developments in the industry?
		Like to supervise?
		Need additional supervisory training?
		Have the capacity to receive constructive criticism?

Selecting Coolant Systems and Pumps for Machine Tools

Providing a proper amount of coolant to the work is one of the most important factors in economical precision machining. Even after you know which coolant to use, and at what pressure and velocity it should be applied, there remains the problem of meeting these requirements as efficiently as possible.

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THE DESIGN of a coolant system and the selection of a pump for machining operations deserve careful consideration from design and tool engineers. Providing an adequate supply of coolant to the work involves many factors. Proper attention to each aspect of the coolant system will pay high dividends in efficiency, quality, and economy. For those faced with the application of coolant to one machine or to a group of them, a thorough understanding of coolant problems will be invaluable.

The principal function of a coolant is to maintain a uniform temperature of the work and the cutting tools. Furnishing coolant to the work helps to prevent overheating of the metal, and therefore minimizes the possibility of changes in hardness or metallurgical structure. It also aids in obtaining good surface finish.

Coolant on the tool helps to maintain the desired cutting edge for a longer period of time, with a resultant saving in sharpening costs and less down time for tool changes. On grinding machines, the coolant prevents the rapid wear or early failure which can result from overheating of the wheel. Liquid flowing over the work also helps keep the chips clear of the machining area, thereby contributing to improved finish and allowing the operator to observe his work. Provision of adequate coolant equipment will allow operation at higher speeds and increased feeds.

There are two principal methods of supplying coolant: through an individual system attached to or built as an integral part of each machine, or through a centralized system serving many machines. It is sometimes desirable to combine the two methods to meet special service conditions. In any case, the choice is usually governed by the type and location of the machines requiring coolant, and by the similarity or dissimilarity of the work and materials being processed on each machine. With a centralized system, it is most practical to serve a group of machines that are close together. In this way it is possible to avoid long pipe runs and many fittings, which might create wastefully high friction losses. There is no advantage in a centralized system unless the identical coolant is required at each machine.

Individual Machine Coolant Systems

Individual machine coolant systems are the most popular, and considered best for economical operation on job-shop, diversified, or relatively small operations. Such systems consist of a tank, an integral pump, and essential piping and valves.

The tank is often an integral part of the machine, built into the base or bed. When this is not convenient, a separate unit is usually located on the floor beside the machine. Tanks should be of adequate volume to allow chips or foreign particles to settle. Another factor in determining the necessary tank size is that of allowing the coolant, warmed by contact with the work, to cool off before being recirculated. In general, tank capacity should be three or more times the rated pump capacity, so as to reduce the possibility of overheating the coolant. The danger of overheating is usually greater in high-pressure applications, and in such cases, appropriate provisions should be made to increase the tank capacity accordingly.

The greater the ratio of tank-to-pump capacities, the more complete is the settlement of chips before the coolant is recirculated. To aid in the settling of chips, it is customary to use baffle plates, as seen in Fig. 1. Such baffle plates channel the flow of coolant over a greater distance within the tank. Improved surface finishes can be

produced on the work when chips or foreign particles are eliminated from the coolant, or reduced to a minimum. In addition, pump and valve life are prolonged due to a resulting reduction in abrasion. For these reasons, filters are sometimes required.

No matter how efficiently the engineer designs the system for optimum performance, it is still the user's responsibility to provide periodic maintenance in order to insure cleanliness and minimize down time. A regular tank-cleaning schedule is important for obtaining the best performance. The engineer, however, must give consideration to this chore, and make it as easy as possible. Integral tanks in the bed of the machine should be easily accessible, and covers should be provided that can be removed easily when necessary. Wide flanges making corners difficult to reach should be avoided.

Another consideration should be the ease with which it is possible to change from one type of coolant to another. To facilitate such changes, a simple means for draining the tank must be provided. This is especially important for small shops which might be required to use one machine for a multitude of jobs, with different coolants needed for various operations.

Centralized Coolant Systems

Centralized systems are used to circulate coolant to a large number of machines when a single coolant is suitable for all operations. In addition to the need for a tank, pump, and valves, it is not unusual to incorporate a means for automatic chip removal and filtering of the coolant. Automatic removal eliminates the rapid accumulation of chips normally occurring when several machines return their coolant to a single source. Filtering is normally adopted when fine surface finishes on the work are required.

The centralized system requires a pump and motor capable of delivering a large volume of liquid. This single pump circulates the liquid under relatively low pressure. If certain machines are required to perform operations that demand high-pressure coolant—for example, deep-hole drilling—they are usually provided with a booster pump. The type of pump used for booster service is determined by operating conditions, and may be of either the centrifugal or positive displacement type.

The single pump and motor used with a centralized system should require less maintenance than the several pumps and motors required for

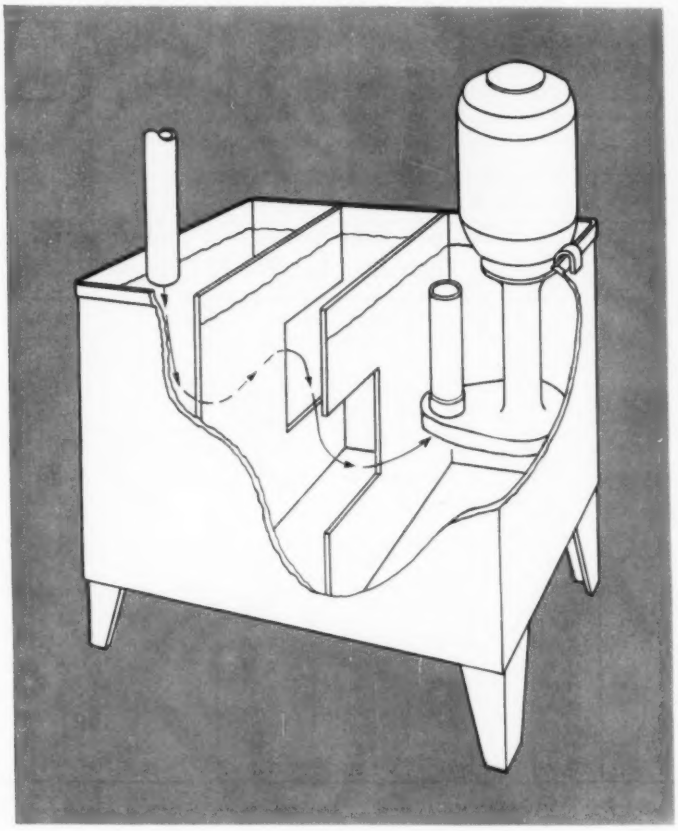


Fig. 1. Schematic cutaway view of a coolant tank shows baffle plates employed to channel coolant over a winding course from the return pipe (left) to the centrifugal pump (right).

Fig. 2. Sample problem demonstrating method of calculating the total net head (pressure) against which a pump must operate in an individual machine coolant system. Tables 1 and 2 are used in the calculations.

Assume discharge to be 15 gallons per minute of oil (100 Saybolt Universal Seconds) through 3/4-inch piping.

Static Head

Distance from liquid level to discharge ..... 3 feet

Friction Head

Total length of straight pipe *A* ..... 5.0 feet
Length of straight pipe equivalent to flexible hose *B* ..... 3.5 feet
Straight-pipe equivalent of four 90-degree elbows *C* at 2.2 feet each (From Table 1) 8.8 feet
Length of straight pipe equivalent to one straight cock *D* (estimated) ..... 1.0 feet
Total equivalent length of straight pipe ..... 18.3 feet

From Table 2 (Friction Loss in Pipes), the loss in 100 feet of 3/4-inch pipe equals ..... 80 feet

For 18.3 feet of straight pipe the loss would be

$$80 \times \frac{18.3}{100} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{ 14.7 feet of oil}$$

Velocity Head

For 3/4-inch pipe, the gallons per minute at 1 foot per second velocity = 1.66

For 15 gallons per minute, $\frac{15}{1.66}$ .. 9.03 feet per second

Velocity head = $\frac{(9.03)^2}{64.4}$ ..... 1.3 feet of oil

Total Head

Static Head ..... 3.0 feet of oil
Friction Head ..... 14.7 feet of oil
Velocity Head ..... 1.3 feet of oil
Total Net Head ..... 19.0 feet of oil

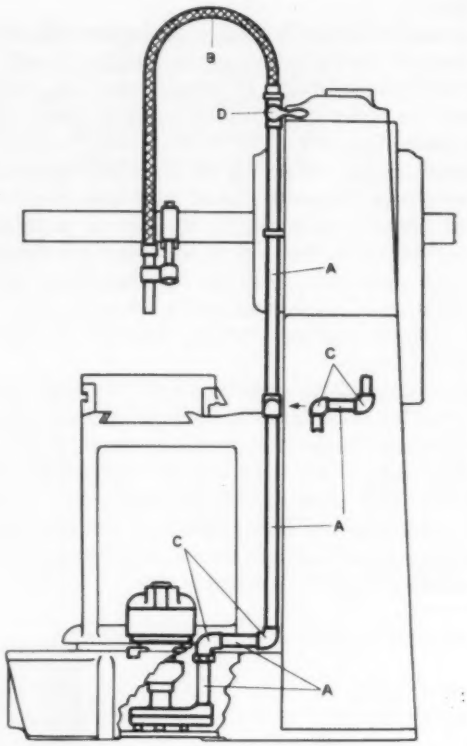


Table 1. Dimensions and Capacities for Standard Pipes, and Equivalent Lengths of Straight Pipe for Various Fittings

Pipe Size, Inches	Standard Pipe Specifications				Equivalent Feet of Straight Pipe for Fittings*			
	Outside Diameter, Inches	Inside Diameter, Inches	Internal Area, Square Inches	Gallons per Minute at One Foot per Second Velocity	45° Elbow	90° Standard Elbow	Standard Tee	Globe Valve (Open)
1/8	0.405	0.27	0.06	0.18	0.4	0.7	1.5	7.0
1/4	0.540	0.36	0.10	0.32	0.5	1.0	2.0	9.5
3/8	0.675	0.49	0.19	0.60	0.6	1.3	2.7	13.0
1/2	0.840	0.62	0.30	0.95	0.8	1.6	3.3	17.0
3/4	1.050	0.82	0.53	1.66	1.0	2.2	4.5	21.0
1	1.315	1.05	0.86	2.69	1.3	2.8	5.7	28.0
1 1/4	1.660	1.38	1.50	4.65	1.7	3.7	7.6	37.0
1 1/2	1.900	1.61	2.04	6.35	2.0	4.4	9.2	43.0
2	2.375	2.07	3.36	10.5	2.5	5.2	11.5	54.0
2 1/2	2.875	2.47	4.79	14.9	3.0	6.4	14.0	65.0
3	3.500	3.07	7.39	23.0	3.7	8.2	17.0	82.0

*This data is based on average piping conditions and is for approximate use only.

Table 2. Friction Losses in Various Sizes of Pipes for Several Flow Rates of Liquids Having Different Viscosities

The following data is approximate only and based on conditions in average steel pipe. Considerable variation in friction loss may be noted between extremely smooth or extremely rough interior surfaces.

Tables give friction losses **per 100 feet of pipe** in feet of the liquid being handled. To convert loss to feet of water multiply figure in table by specific gravity of liquid.

Viscosity, Saybolt Universal Seconds	Flow of 1 Gallon per Minute					Flow of 3 Gallons per Minute				
	Pipe Diameter, Inches					Pipe Diameter, Inches				
	3/8	1/2	3/4	1	1 1/4	3/8	1/2	3/4	1	1 1/4
32 (water)	3.7	1.3	0.33	0.11	0.03	26.	5.9	2.2	0.72	0.21
50	8.	3.3	1.	0.39	0.13	43.	9.4	3.1	1.2	0.39
100	21.	8.3	2.7	1.	0.37	63.	25.	8.1	3.1	1.1
500	110.	43.	14.	5.4	1.9	330.	129.	43.	16.	5.7
1000	225.	88.	30.	11.	3.8	675.	264.	90.	33.	11.
3000	700.	275.	91.	34.	12.	2100.	825.	273.	100.	35.
10000	2350.	940.	310.	115.	40.	7050.	2820.	930.	345.	120.
20000	4800.	1900.	625.	233.	81.	14400.	5700.	1875.	699.	243.
40000	9700.	3850.	1270.	470.	164.	29100.	11550.	3810.	1410.	492.

Viscosity, Saybolt Universal Seconds	Flow of 5 Gallons per Minute					Flow of 10 Gallons per Minute				
	Pipe Diameter, Inches					Pipe Diameter, Inches				
	3/8	1/2	3/4	1	1 1/4	1/2	3/4	1	1 1/4	1 1/2
32 (water)	62.	21.	5.5	1.72	0.51	92.	18.	5.8	1.7	0.76
50	103.	34.	9.3	2.	0.65	125.	31.	9.8	2.8	1.3
100	105.	42.	14.	5.2	1.9	173.	37.	10.5	3.7	1.9
500	550.	215.	72.	27.	9.5	430.	143.	54.	19.	9.8
1000	1125.	440.	150.	55.	19.	880.	300.	110.	38.	20.
3000	3500.	1375.	455.	168.	59.	2750.	910.	335.	118.	60.
10000	11750.	4700.	1550.	575.	200.	9400.	3100.	1150.	400.	210.
20000	24000.	9500.	3125.	1165.	405.	19000.	6250.	2330.	810.	420.
40000	48500.	19250.	6350.	2350.	820.	38500.	12700.	4700.	1640.	850.

Viscosity, Saybolt Universal Seconds	Flow of 15 Gallons per Minute					Flow of 20 Gallons per Minute				
	Pipe Diameter, Inches					Pipe Diameter, Inches				
	3/4	1	1 1/4	1 1/2	2	1	1 1/4	1 1/2	2	2 1/2
32 (water)	37.	12.	3.4	1.16	0.46	20.	5.7	2.5	0.78	0.34
50	63.	20.	5.8	2.6	0.68	32.	9.5	4.3	1.3	0.56
100	80.	25.	6.5	2.9	1.1	41.	12.2	5.2	1.4	0.68
500	215.	81.	29.	15.	5.4	108.	38.	20.	7.2	3.7
1000	450.	165.	57.	30.	11.	220.	76.	40.	14.	7.4
3000	1365.	503.	177.	90.	33.	670.	236.	120.	44.	23.
10000	4650.	1725.	600.	315.	113.	2300.	800.	420.	150.	78.
20000	9375.	3495.	1215.	630.	233.	4660.	1620.	840.	350.	156.
40000	19050.	7050.	2460.	1275.	452.	9400.	3280.	1700.	602.	310.

Viscosity, Saybolt Universal Seconds	Flow of 30 Gallons per Minute				Flow of 50 Gallons per Minute			
	Pipe Diameter, Inches				Pipe Diameter, Inches			
	1 1/4	1 1/2	2	2 1/2	1 1/4	1 1/2	2	2 1/2
32 (water)	12.	5.2	1.5	0.67	29.	13.	3.9	1.7
50	20.	8.5	2.7	1.1	48.	21.	6.4	2.7
100	25.	11.	3.3	1.4	61.	27.	8.2	3.6
500	57.	29.	11.	5.5	95.	49.	18.	9.4
1000	114.	60.	22.	11.	190.	100.	36.	19.
3000	354.	180.	66.	34.	590.	300.	110.	57.
10000	1200.	630.	225.	116.	2000.	1050.	375.	195.
20000	2430.	1260.	466.	234.	4050.	2100.	875.	390.
40000	4920.	2550.	903.	465.	8200.	4250.	1505.	775.

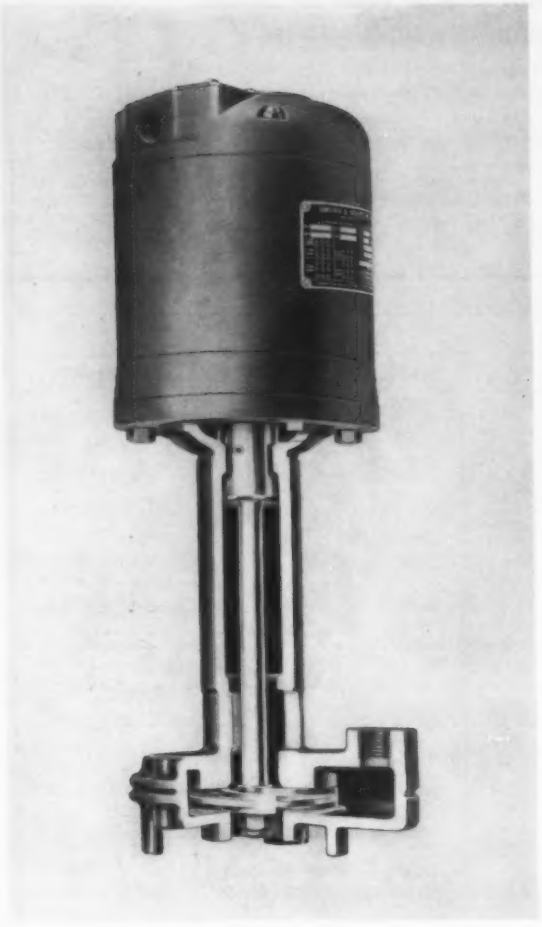


Fig. 3. (Above) Centrifugal pump contains an impeller which forces incoming fluid (entering at center) to follow a circular path within the housing. Centrifugal force propels the liquid to the outlet at the periphery of the circular housing.

the individual systems. This is the chief economical advantage of such systems. However, centralized systems lack flexibility, and are suited only to limited types of operations. Continuous production cycles, such as those common in the automobile industry, are typical of the best applications for centralized systems.

Choice of a Coolant

Coolants range from low-viscosity water-soluble oils, and kerosene-base petroleum (30 to 35 seconds standard Saybolt universal) to cutting oils having a viscosity of approximately 300 seconds standard Saybolt universal. There are also many new synthetic fluids having fire-resistant characteristics, with comparable viscosities. Also available are a large number of special compounds, formulated to provide improved operation or superior surface finish under a variety of conditions.

No single system can handle such a variety of coolants with optimum efficiency. Design engineers should consider those coolants that are rated best for the specific operations to be done on the projected machines. Whenever in doubt, the user can obtain valuable information from the major oil companies and manufacturers of coolants, who have compiled extensive data on the subject.

The Pump is the Heart of the System

Selection of the coolant pump should be the result of much deliberation. Among the many factors to be considered are:

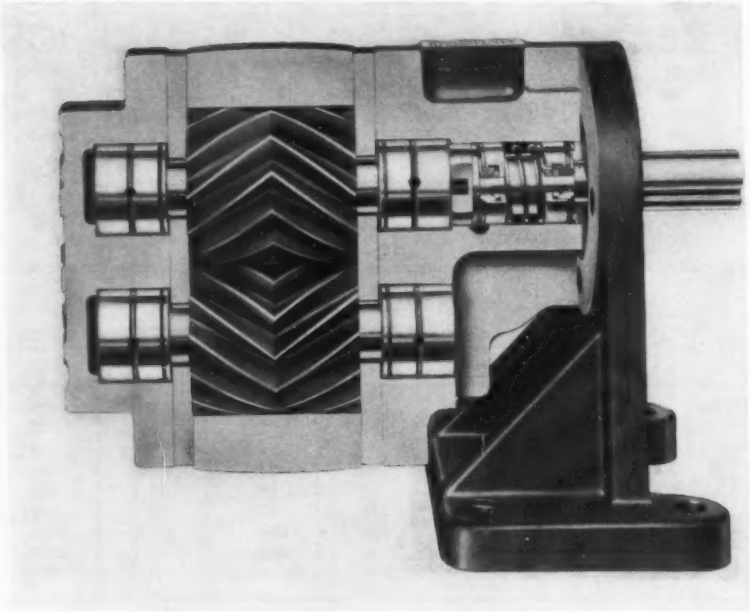


Fig. 4. (Right) In this gear type, positive-displacement pump, fluid is trapped in the spaces between the opposing gears. Since the spaces are constant, the pump moves the same amount of fluid per revolution for any pressure.

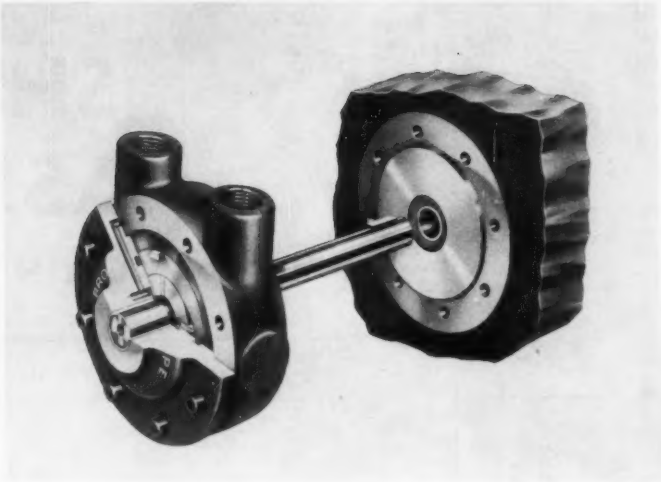


Fig. 5. Vane type, positive-displacement pump has spring-actuated vanes mounted on a carrier that is eccentrically fixed with relation to the housing. Incoming liquid is trapped in large-volume spaces.

1. Volume of liquid required to be pumped in gallons per minute.
2. Pressure necessary to deliver the coolant.
3. Characteristics of the liquid:
   (a) Viscosity;
   (b) Base—water, oil, or synthetic;
   (c) Operating temperature.
4. Available space;
5. Type of pump drive.

An approximation of pump performance requirements can be obtained through the use of the accompanying tables and the problem in Fig. 2.

The pump should be chosen with a view toward obtaining the best performance under conditions of continuous operation. Since it can be expected that there will be chips present in most coolant applications, the centrifugal pump is the most popular type for such service. Centrifugal pumps, such as the one shown in Fig. 3, are capable of circulating liquids laden with abrasives without appreciable damage to the pump. Also, they are designed for high-volume, low-pressure conditions, and, therefore, have limited applications. The action of the impeller in imparting centrifugal force to the liquid provides sufficient velocity for propelling it through the discharge or outlet pipe.

Centrifugal pumps are most efficient when operated at fairly high speeds (1800 to 3600 rpm), and with low-viscosity liquids. The centrifugal pump is capable of continually recirculating the liquid within the impeller housing, and a relief valve is not necessary. Volume through the discharge line can be controlled with a simple gate or globe valve. There is no danger of damage, even if the valve should be completely closed. If operating conditions can be satisfied with a centrifugal pump, it should be the first choice of a coolant user.

Discharge pressures of 50 pounds per square inch or higher, while not impossible with centrifugal pumps, usually dictate the use of a positive-displacement type. Positive-displacement pumps may be of the gear, vane, or piston type—the choice being largely a matter of opinion, but subject to the cost and the amount of space available. The gear type pump (Fig. 4) is the most common of the positive-displacement units used for coolant circulation. Some users, however, prefer vane pumps such as the one seen in Fig. 5. Vane pumps are often smaller in size but somewhat less rugged.

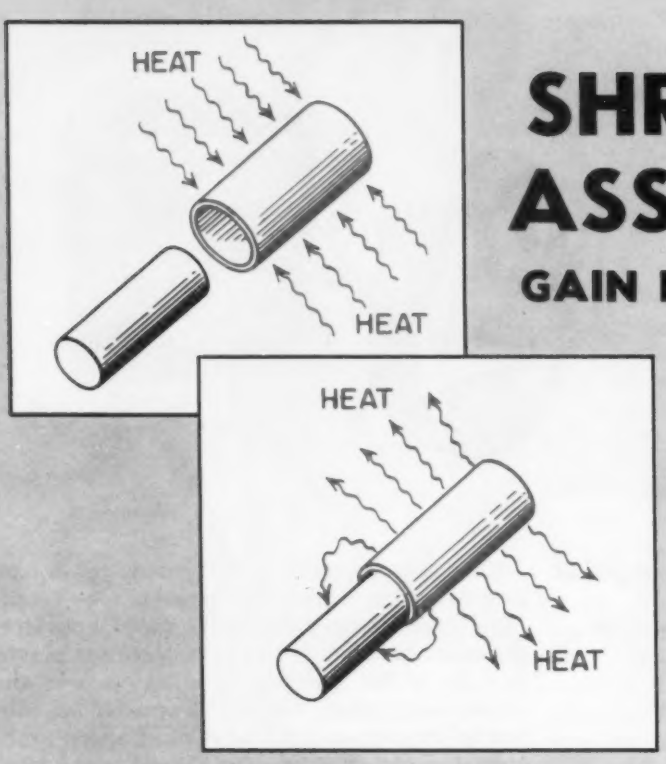
Because all positive-displacement pumps are assembled with extremely small internal clearances, the problem of abrasion from foreign particles is serious. Pump life is usually governed by the cleanliness of the liquid, and, to a certain degree, by the operating pressure. The dirtier the liquid and the higher the pressure, the shorter the pump life. Observations of many applications of positive-displacement pumps suggest that the following procedures be followed in order to obtain best results:

1. Use a filter in the system, preferably on the intake side of the pump. It is recommended that a reputable filter manufacturer be consulted for his recommendations.

2. Keep the tank clean to reduce the load on the filter.

3. Use a coolant having good lubricating characteristics. The oil film will permit the passage of particles through the pump with a minimum amount of damage.

Filters should be selected primarily to obtain the best surface finish on the work. Even if this is not important to the job, pump life will be extended in proportion to the effectiveness of the filtering system.



SHRINK-FIT ASSEMBLIES

GAIN IN POPULARITY

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SHRINK-FITTING, once considered an excellent but costly method of assembly, becomes a practical manufacturing technique when teamed with induction heating.

In shrink-fitting, two cylindrical parts usually are involved, the outside of one part assembling to the inside of the other. The outside diameter of the internal part is machined slightly larger than the inside diameter of the external part. To accomplish the shrink-fit, the internal part is cooled to decrease its diameter and at the same time the external part is heated to increase its diameter. While the one is cool and the other is hot they are fitted together and allowed to return to room temperature. Sometimes, cooling the internal part is eliminated if enough heat can be applied to the external part quickly, and in such a way that no undesirable changes are effected.

In the past, shrink-fit assemblies were found only in precision equipment, like machine tools. Holding the necessarily close dimensions of the mating surfaces of the members was too costly for ordinary manufacturing assemblies. But with the vast improvement in metalworking practice over the last twenty years, closer parts tolerances are now held without appreciable increase in cost. Thus, shrink-fit assemblies are becoming increasingly competitive with standard fastening devices. This is particularly true where induction heating equipment has been installed. Many parts can now be heated in a matter of seconds.

With such a fast heat cycle possible, a complete assembly frequently can be made in eight to fifteen seconds. By contrast, the external member formerly had to be heated in a furnace for two hours, and the internal member had to be refrigerated for four to six hours.

The General Electric Co. shrink-fits a stator to the motor housing for one of its appliances in an assembly cycle time of eighteen seconds. In this instance, the usual fastening devices—three long bolts, nuts, and washers—had been eliminated. Savings in time and material over the old assembly method prompted the company to adopt the technique for another appliance. In this second application, compressors and stators are shrink-fitted to housings, and compressor shafts are shrink-fitted to a rotor.

Some automobile companies are shrink-fitting ring gears to flywheels. Tractor manufacturers are using shrink-fits for the assembly of main

drive gears to hubs, and pulleys to shafts. Also, steering knuckles are being shrink-fitted to steering knuckle posts, replacing a press-fitting operation, and eliminating a scrap loss of 10 per cent. In another instance, an average of seventy defective assemblies per week was virtually eliminated by a commercial refrigeration manufacturer, by abandoning press-fitting stators to housings in favor of shrink-fitting.

The controlling factor in shrink-fitting is usually the length of the heating interval, which, in turn, is largely influenced by the amount of interference between the parts. This is based on the pressure required. For thick, hollow cylinders under external and internal pressure, the equation* for this force is:

$$P = \frac{E\triangle\ (B^2 - A^2)\ (C^2 - B^2)}{B\ 2B^2\ (C^2 - A^2)}$$

where P = pressure in pounds per square inch;
E = modulus of elasticity;
A = inner radius of inner cylinder;
B = outer radius of inner cylinder;
C = outer radius of outer cylinder;
$\triangle$ = actual interference between the cylinders.

This force should be kept to a minimum, to reduce the heating time and eliminate the possibility of developing fractures because of overstressed parts. However, under all conditions, the maximum stress theory should be used to provide a fast check on good design practice. Maximum tensile stress on the inner surface in a tangential direction can be calculated for thick, hollow cylinders from this equation†:

$$St = \frac{P\ (A^2 + B^2)}{(B^2 - A^2)}$$

where St = maximum tensile stress;
P = pressure in pounds per square inch (found from the preceding equation);
A = inside radius;
B = outside radius.

For the cylinder subjected to external pressure, the maximum compressive stress on the inner surface is:

$$Sc = \frac{2\ PB^2}{B^2 - A^2}$$

where Sc = maximum compressive stress.

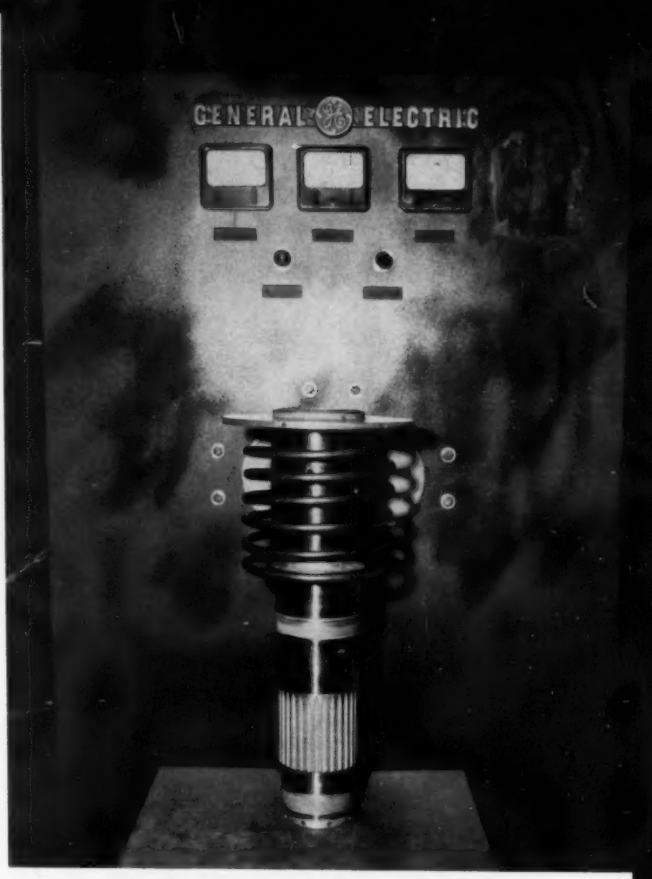

Fig. 1. The Navy Department uses this setup to heat a plugging assembly for shrink-fitting it to a propeller shaft. The induction heater, rated at 7 1/2 kilowatts, raises the work to 900 degrees F. in six minutes.

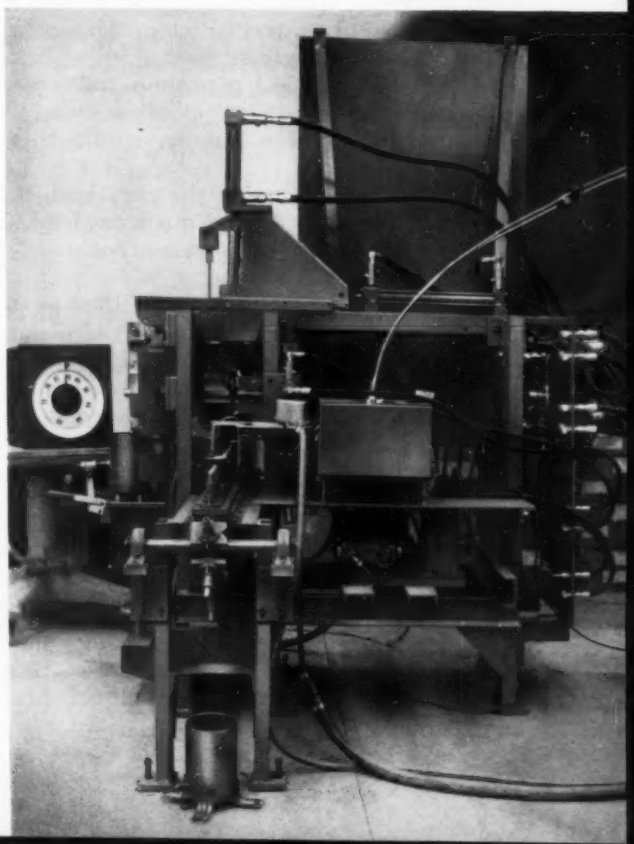

Fig. 2. Rotors are shrink-fitted to shafts on a production-line basis. This equipment has a 40-kilowatt induction heater which raises the work to 650 degrees F. One assembly is produced every twenty seconds.

As the required pressure decreases, less heating time and lower working temperatures are needed for preparing and assembling the two parts. Lower working temperatures facilitate material handling and minimize distortion from heating. Thinner cylinder wall sections can be used with lower pressures, reducing the volume of metal to be heated.

The temperature which the outer cylinder must reach is based on the coefficient of linear expansion of the metal involved and the interference between the parts. The approximate coefficients of linear expansion for some of the standard production shrink-fit materials, per degree up to 725 degrees F., are:

Aluminum	9.4×10^{-6}
Gray cast iron	5.89×10^{-6}
Wrought iron	6.33×10^{-6}
Brass	10.4×10^{-6}
Steel	5.6 to 7.3×10^{-6}

For most applications, an induction heater of the proper kilowatt rating should be used with a multiple-turn, loosely coupled high-voltage coil. Such a setup provides a fast heating cycle, at the same time limiting the power density so as to prevent overheating. Frequency can also be important. A rule of thumb—the thicker the wall, the lower the frequency—is true because lower frequencies provide deeper current penetration. The proper frequency is determined by the size of the parts to be heated.

So far as the cooling time is concerned it must be sufficient to allow the outer cylinder to shrink onto the inner with enough force to preserve any specific relation between the parts. The entire shrink-fitting cycle time is, of course, also influenced by the fixturing devised for assembling the parts. It can be anything from a plain arbor press or air cylinder, to a completely mechanized machine, according to how elaborate the production requirements are.

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*Timoshenko & Lessells—*Applied Elasticity*

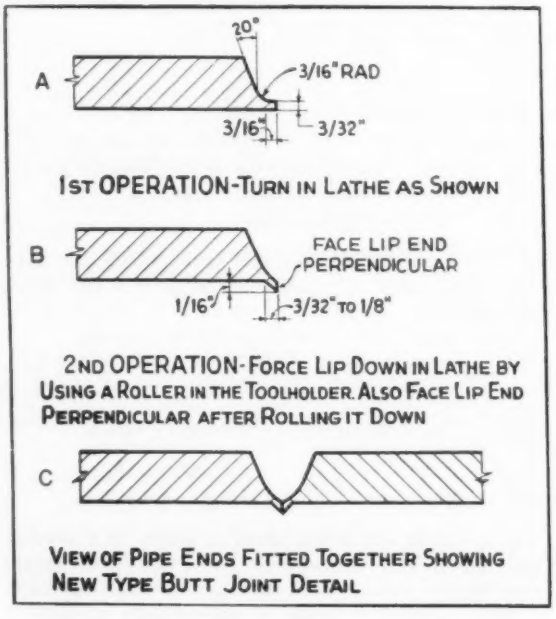
†Swain—*Strength of Materials*

Arc Welding of Pipe Butt Joints without Backing Ring

An arc-welding process which eliminates the need for metallic backing rings or inserts when welding butt joints in pressure piping systems is being successfully applied by Stone & Webster Engineering Corporation, Boston, Mass. This inert-gas shielded welding procedure is being used for power, chemical, petroleum, and nuclear installations, and for other applications where it is necessary to produce a uniform inside bead condition.

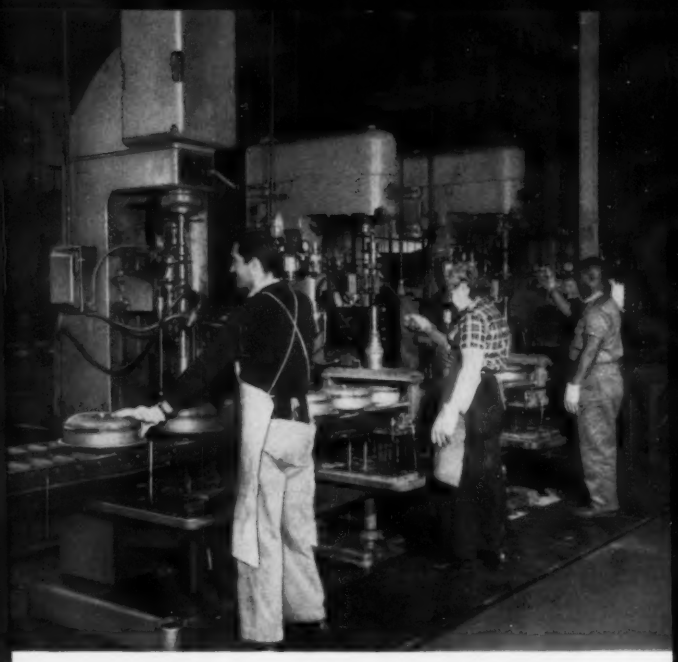
Experience indicates that the costs with this method will be lower and the quality superior to other welding techniques previously employed. A major feature of the process, which was developed by R. T. Pursell, Stone & Webster metallurgical engineer, is the novel manner of preparing the root edges of the pipe joint prior to performing the welding operation.

As shown in the accompanying drawing, the root edges are turned in a lathe as seen at *A*, and bent down to produce an internal, circumferential lip *B*. When the edges of this type of joint are fused together in an inert-gas atmosphere, the inevitable concave condition associated with other methods is eliminated. Paper dams employed for the process are subsequently burned with an oxy-acetylene flame or by means of stress-relieving coils.


20°
A
3/16" RAD
3/16"
3/32"
1ST OPERATION-TURN IN LATHE AS SHOWN
B
FACE LIP END PERPENDICULAR
1/16"
3/32" TO 1/8"
2ND OPERATION-FORCE LIP DOWN IN LATHE BY USING A ROLLER IN THE TOOLHOLDER. ALSO FACE LIP END PERPENDICULAR AFTER ROLLING IT DOWN
C
VIEW OF PIPE ENDS FITTED TOGETHER SHOWING NEW TYPE BUTT JOINT DETAIL

Method of preparing root edges of the pipe joint for inert-gas shielded arc-welding process which eliminates the need for metallic backing rings or inserts

Roller Burnishing — a Low-cost Method of Producing Smooth Surfaces



C. R. MORRIS
Tool Engineer, Highland Park Plant
Chrysler Corporation
Detroit, Mich.

MULTIPLE-ROLLER burnishing tools are being employed to produce high quality, smooth surfaces rapidly and economically at the Highland Park plant of Chrysler Corporation, Detroit, Mich. No special machine tools are necessary, and both internal and external cylindrical surfaces on various torque-converter parts are being finished on standard drill presses, as seen in the heading illustration.

Basically, the tools for burnishing external surfaces—made by the Madison-Faessler Tool Co., Moberly, Mo.—consist of a group of axially tapered, hardened steel rollers, equally spaced around the tapered bore of a mandrel by a retaining cage, as seen in Fig. 1. A micrometer adjusting nut is provided to vary the axial position of the rollers with respect to the mandrel bore, for setting to the diameter of the surface to be burnished. These external tools are self-feeding because the rollers are set at a slight angle to the axis of the mandrel.

For burnishing internal surfaces, a spring-expanded tool having three carbide rollers, designed by Chrysler, and seen in Fig. 2, is used. Normally, internal tools burnish as they are fed into the work. However, this tool can be fed either way and burnishing is done during the upward stroke of the tool. This allows blending of the finished bore with the chamfer on the hub bore.

Rolling pressure is automatically released when the tool contacts a stop pre-set on the machine, or by means of a stop-collar on the tool itself. With external tools, the rollers feed forward independently of the tool until they pass beyond the end of the mandrel and then expand. On the internal tools, the rollers are mounted on spring-loaded arms, and set to the desired size and pressure by means of adjusting screws.

A torque-converter assembly on which the bore and periphery of the hub have been roller burnished is shown in Fig. 3. External burnishing of the hub periphery is performed on an Edlund No. 2 drill press. An air-operated, pilot type fixture raises the work-piece against stops and locates from the crankshaft counterbore in the assembly. The tool rotates at 225 rpm and is fed at the rate of 0.060 inch per revolution. Loading, burnishing, and unloading require only sixteen seconds.

While a maximum surface roughness of 10 micro-inches is specified for the hub periphery, a finish of 5 micro-inches is consistently obtained. This external surface is burnished to a diameter of 2.125 inches for a minimum length of 0.63 inch. Ordinarily, where an optimum surface finish is to be produced, burnishing is not a sizing operation. However, if a uniform surface finish is not required on all parts, the tool can be used effectively to control the diameter. This is possible because of the precision adjustment which can be made of the tool size with the micrometer nut calibrated in increments of 0.0001 inch.

Fig. 1. Tool for burnishing external surfaces has nine hardened steel rollers equally spaced around a mandrel by a retaining cage.

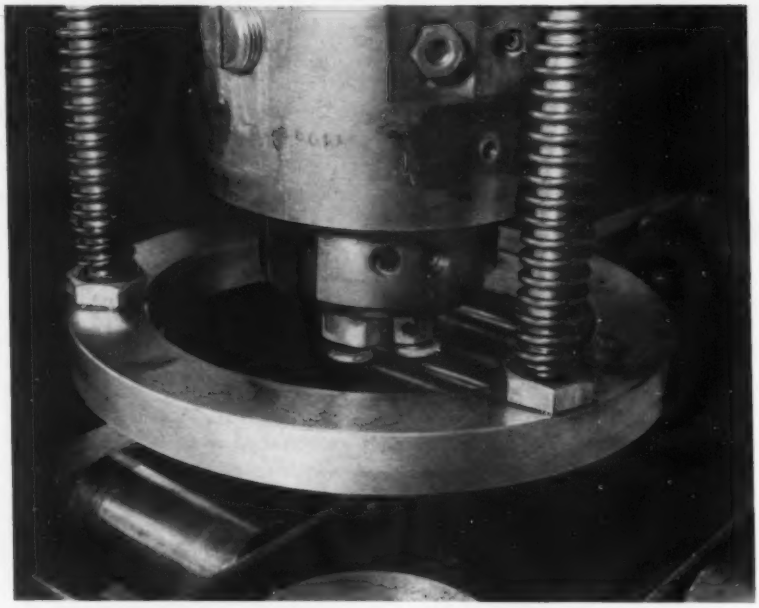


Fig. 2. Internal burnishing tool having three carbide rollers is used to finish bore the hubs on assemblies for torque converters (Fig. 3).

Fig. 3. Both the hub bore and periphery on this torque-converter assembly are roller burnished with the tools shown in Figs. 1 and 2, mounted on standard drill presses.

Actually, the surface finish produced on the work-piece depends on the physical properties of the metal, the surface generated in the preceding operation, and the amount of material to be displaced. As the ridges on the surface are flattened and the depressions filled, metal is displaced perpendicular to the axis of the rolls. Cold-working of the metal increases the hardness and produces a wear-resistant surface. Cross-hatch patterns obtained with previous finishing methods have been eliminated, and final assembly of the parts is facilitated.

The bore of the impeller hub on the torque-converter assembly is roller burnished to a diameter of 1.8755 inches with a minimum depth of 0.60 inch. A finish of 50 micro-inches is permitted on this surface, but 10 micro-inches or less is obtained. This operation is performed on a Buffalo No. 2 drill press with the burnishing tool rotated at 940 rpm, and fed at the rate of 0.004 inch per revolution by means of a cam-operated feed pilot. An air-operated, pilot type fixture, similar to the one used for external burnishing, is used to locate and clamp the work. Also, a spring-loaded ring (Fig. 2), surrounding the tool, holds the part down and prevents it from rotating. Floor-to-floor time is only sixteen seconds.

Another application of roller burnishing at Chrysler is illustrated in Fig. 4. Here, the thrust face of a sheet metal stamping on the torque-converter, front cover assembly is burnished. This operation is performed on a Barnesdril vertical drilling machine equipped with a Bellows feed and a Cogsdill burnishing tool having six radially positioned rollers, each 1/2 inch in diameter by 3/4 inch long. A surface finish of 20 micro-inches maximum is specified for the thrust face on this torque-converter stamping. The face measures 2 5/8 inches in diameter.

Fig. 4. Setup for roller burnishing thrust face on front cover assembly of torque converter. Tool has six radially located steel rollers.

Mechanism Design Program at M.I.T.

The increasing use of high-speed automatic machinery emphasizes the importance to the machine designer of obtaining complex machine motions with minimum dynamic disturbance. To present new developments in this field, the Massachusetts Institute of Technology will offer a special program in design and dynamics of mechanisms during its 1958 summer session from September 2 to 12.

This program will be concerned with the design of mechanisms to achieve a desired output motion, using kinematic synthesis, and with the dynamic analysis of mechanisms to assure satisfactory strength and wear of mechanical parts, with minimum shock and vibration. Linkages, cams, gears, and springs will be considered.

Morning sessions will be devoted to lectures and afternoon sessions to the solution of practical problems. Participants will be invited to submit problems for consideration by the group.

Many of the lectures will be given by Dr. Rudolph Beyer, professor of kinematics and mechanism design at the Technical University, Munich, Germany, who will lecture on synthesis of mechanical linkages for prescribed motion requirements, analysis of static and dynamic forces in mechanisms, and design and analysis of three-dimensional mechanisms. Much of this material is well known in Germany but has not yet been presented in the English language.

The program is intended for men with a background in mechanical design. Familiarity with differential and integral calculus will be helpful for some of the lectures. Dr. Thomas P. Goodman, assistant professor of mechanical engineering at M.I.T., will be coordinator for the program.

HOT-SIZING TITANIUM and HIGH-TEMPERATURE STEEL PARTS

CHARLES O. HERB, Editor

IN THE MANUFACTURE of supersonic planes and the faster projected missiles, the principal problem has been the fabrication of components from titanium and high-temperature resistant steels. Many parts of great variety must be formed from sheets of these materials. With work of this category, difficulties arise in producing the parts accurately to specified dimensions and to required shapes. Such components invariably come from hydraulic presses and drop-hammers with wrinkled flanges and wider surfaces so warped that the parts do not lie flat. It is also difficult to form such work to small corner radii.

At the plant of the Los Angeles Division of North American Aviation, Inc., it was previously the practice to remove wrinkles from such parts and to straighten them by manually hammering the parts against die-blocks similar to those on which they were formed. This bench work was a long and tedious procedure.

Some years ago North American engineers were given the job of developing a more satisfactory method of solving the problem. Their efforts led to the building of several prototype hot-sizing presses on which patent applications are pending. Sheridan-Gray, Inc., Torrance, Calif., has been licensed to build commercial types of these hot-sizing presses, and has already supplied such equipment to North American, the McDonnell Aircraft Co., St. Louis, Mo., and the Production Heat Treating Co., North Hollywood, Calif.

Two Sheridan-Gray presses, installed side by side at the North American plant so that they can be used individually or as one unit, are shown in Fig. 1. At the time the photograph was taken, a part was being hot-sized in the one press, while another part was being removed from the second unit. In addition, three prototype models are in daily use. The work-pieces handled by these hot-sizing presses are as heavy as 0.093 inch in thickness and as light as only 0.005 inch. On many parts dimensional tolerances of plus or minus 1/32 inch are specified, although it is possible to produce parts to size within 0.003 inch, and there are occasions when tolerances almost this close are specified. Parts are hot-sized in less than 8 per cent of the time formerly required with bench work, and are far more accurate.

In the heading illustration, a man is seen holding in his right hand a part wrinkled and warped as it comes from a hydraulic press. In his left hand is an identical part that has been hot-sized.

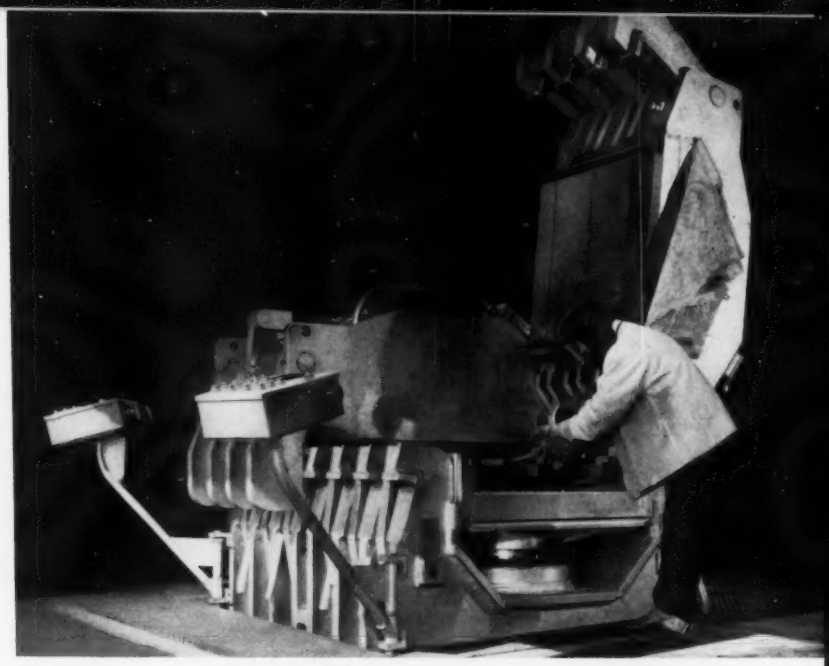


Fig. 1. These two hot-sizing presses are installed close together to enable their use individually or as one unit for longer work.

The difference in work quality is readily apparent. At the right in Fig. 2 are shown a variety of titanium and titanium-alloy parts as they come from the forming equipment. At the left are similar parts after they have been hot-sized. Before the work-pieces come to the hot-sizing operation, they are stress-relieved by annealing.

In the hot-sizing operation, the work-piece is placed upon an electrically heated bottom platen of the press, as shown in Fig. 3, over the form-block that was used when the part was produced on a hydraulic press or drop-hammer. In front and back of the work-piece and form-block are mating die members. With the work in place, an overhead hinged lid with an electrically heated platen attached to it is lowered and locked in place by engaging toggles on the lid with heavy lugs at the front of the machine bed. In Fig. 3 the work is so long as to require the use of two presses. The work and dies extend across the bottom platen of both machines and will be covered by the top platens of both units.

Horizontal rams at the front and back of each press are then actuated to exert a pressure of 75 tons per press through sliding jaws to force the die members against the work. Then a maximum pressure of 300 tons is exerted by a vertical hydraulic cylinder beneath each of the bottom platens to force the work and dies against the upper hot platens. Pressure is applied for a predetermined length of time, which normally varies from five to ten minutes, depending upon the gage thickness and configuration of the part and the amount of metal movement required, after which the pressure is released and the lids are raised to enable removal of the work.

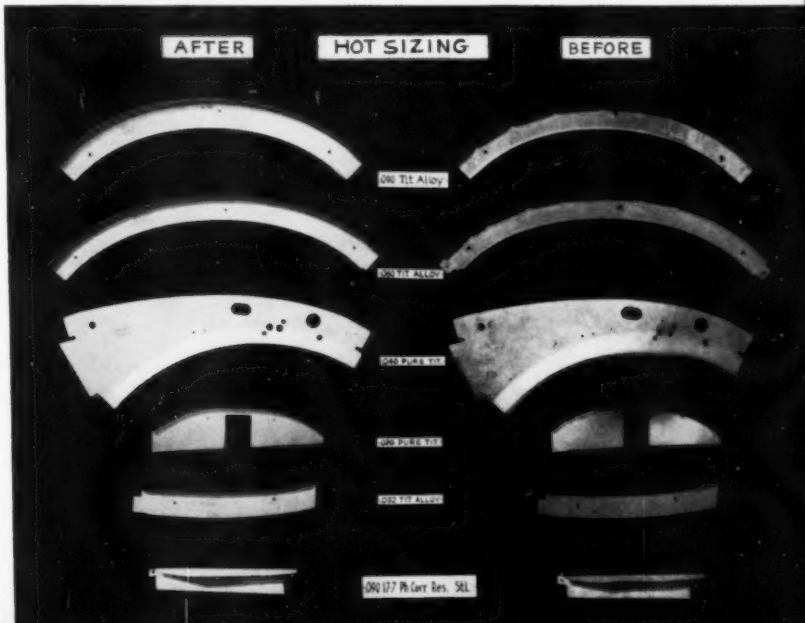


Fig. 2. Various cold-formed parts of titanium and stainless steel before and after hot-sizing to eliminate wrinkles and warped surfaces.

Fig. 3. Hot-sizing presses of modular installation with both lids raised to show how both machines can be used together for long work.

With two presses arranged as seen in Fig. 3, either one long part can be conveniently handled or two work-pieces of shorter length and different configuration. The appearance of this equipment when the lids are clamped and work is being hot-sized is seen in Fig. 4.

All operations of the presses, including raising and lowering of the lids, up-and-down movement of the vertical ram, and the in-and-out movements of the sliding jaws actuated by the side pressure cylinders, are controlled from a push-button stand at the front of the equipment. The platens of these presses can be heated to temperatures up to 1400 degrees F. The machines are generally kept at the working temperature for the full working week and are shut down over week-ends only. The dies are, of course, thoroughly heated by contact with the platens before work is handled. The die members are made of tool steel or Meehanite. They are machined without any allowance for spring-back or growth. This has resulted in an appreciable saving in tool costs because the dies employed in the cold-forming of the work-pieces can also be used in hot-sizing.

When work-pieces are taken from the hot-sizing presses, they are allowed to cool to room temperature without restraint. The parts are then of high structural quality because there are no residual stresses in the metal. Scrap loss has been reduced since the adoption of this method of bringing work closely to size, and "joggle-setting" has been eliminated. Because the parts are hot-sized, it is economical to cold-form them.

Presses of various sizes have been designed by Sheridan-Gray, Inc., from a 24- by 24-inch by 100-ton model up to a 48- by 48-inch by 1000-ton model. They may be provide with equipment for heating the platens to temperatures from 1200 to 1800 degrees F. The 1800-degree platens can be supplied with die-cushion cylinders.

A press recently built for the McDonnell Aircraft Co. is illustrated in Fig. 5. This machine

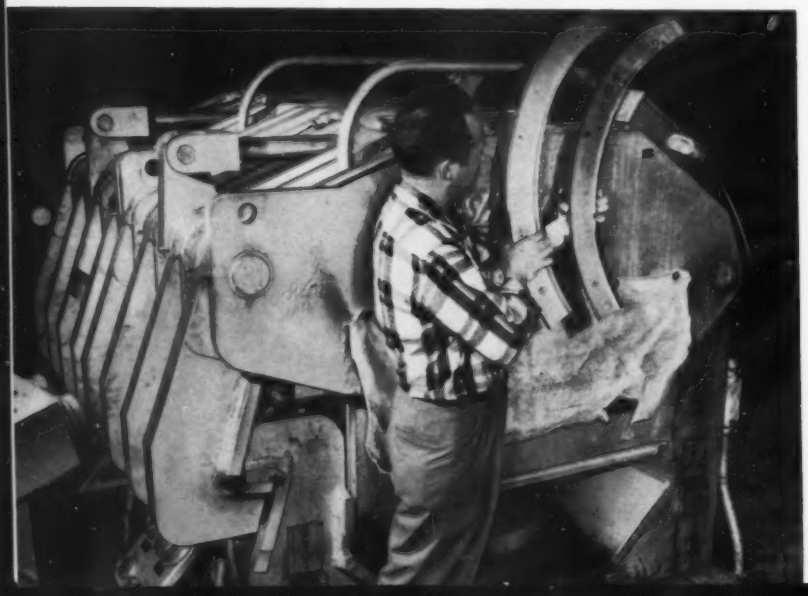


Fig. 4. The hot-sizing presses shown in Fig. 3 are seen here with both lids closed for an operation on either one long or two short parts.

Fig. 5. Hot-sizing press built for use by the McDonnell Aircraft Co. on a large variety of work that is hard to cold-form accurately.

also has a 300-ton vertical ram and three horizontal cylinders at the back and at the front for delivering a pressure of 75 tons in either direction. The plungers of these cylinders are vertically adjustable to permit the side pressure to be applied normal to the tooling and on the center line of dies up to 6 inches high.

A close-up view of typical dies employed on this press is shown in Fig. 6. As on all presses of the type here being discussed, the bottom platen is provided with slots to receive keys that engage slots in the bottom of the die members. This arrangement insures that the die members are always aligned in correct relationship with each other. This feature is especially important when using matched radius tools or dies containing joggle-forming surfaces. The dies are attached to the plungers of the horizontal cylinders so that they retract with them to facilitate work removal.

The hydraulic power unit seen at the far end of the press in Fig. 5 differs from conventional units in that it is designed to use a fire-resistant fluid. Special seals provided on the valves and pumps withstand chemical reaction of the fire-resistant oils. To insure a leakproof system, use is made of a rifle-drilled solid steel manifold block with flange-mounted valves. This eliminates the need for many connecting lines and fittings.

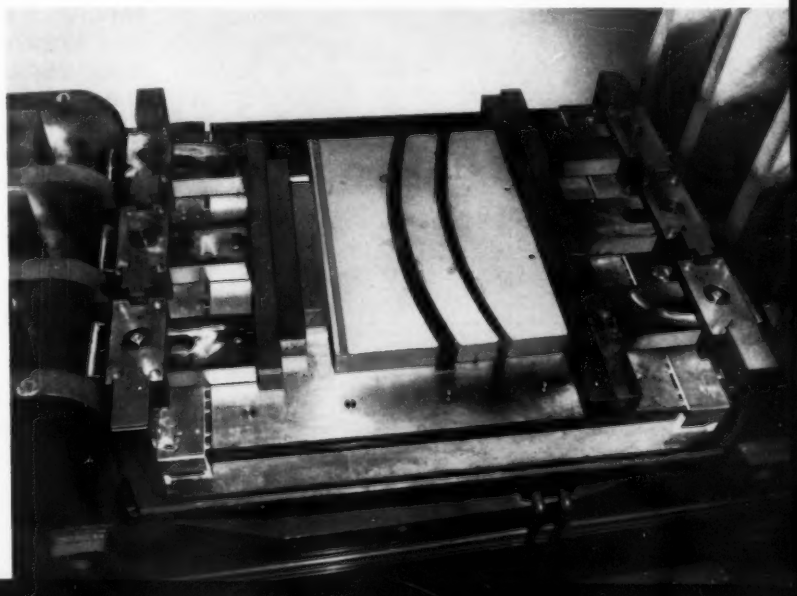


Fig. 6. The bottom platen of the press seen in Fig. 5 is provided with T-slots to insure constant proper relationship of all die members.

"Electropoint" System Runs Turret Drills

BURGMASTER TURRET DRILLS can now be run from a punched tape even a novice can prepare after only ten minutes' instruction. Blueprint decimal information is punched directly into the tape. No electronic computer is required to establish the coordinate points necessary to program operations. Moreover, no code book is required.

This "Electropoint" system, as it is called, is tied in mechanically with the two lead-screws in the machine table. It combines the accuracy of numerical techniques with the direct measurement of analog devices.

The principle is one of continuous numerical measurement. There is no dependence on past movements, power failure, or the point at which the machine is started. Further, the system does not rely on the counting of pulses, phases, or of spectral lines, where a single error in calculating can be carried throughout a program. It is possible to start an automatic program from any position, to intersperse manual movements with the tape, to re-start the automatic cycle at any point, and to operate indefinitely without returning to the reference position.

BURGMASTER-ELECTROPOINT PROGRAMMING SHEET PAGE 1 OF

FIRM: PART NO.

DEPT: BURGMASTER MODEL USED — 28HT 6 SPINDLE ☒ 28HT 8 SPINDLE ☐

OPERATION NO. TEST PART

OPERATION LETTER OR NUMBER	OPERATION TO BE PERFORMED	CO-ORDINATES X-AXIS	CO-ORDINATES Y-AXIS	SPINDLE SEQUENCE
A	27/64 DRILL	9.000	5.000	4
B	"	8.000	5.000	4
C	"	7.500	6.500	4
D	"	9.000	6.000	4
E	"	10.500	6.500	4
F	"	10.000	5.000	4
G	"	10.500	3.500	4
H	27/64 DRILL and 7/16 REAM	9.000	4.000	4 2
B	7/16 REAM	8.000	5.000	4
D	"	9.000	6.000	2

Punching the Mylar Film

One method for preparing the data is to use the center of table travel as a reference position, and to write down the distance to each drilling location on the blueprint (or on a copy of it). A

Fig. 1. This programming sheet shows the coordinates for each drilling location and the spindle sequence to be followed.

programming sheet, Fig. 1, is then filled out with the operation sequence, the X and Y coordinates, and the spindle sequence.

The tape, an endless belt of Mylar film, is punched manually from the programming sheet information in binary coded decimal form in two parallel rows, one for the X position and one for the Y position of the table. In Fig. 2 are shown the simple punching apparatus and a partly programmed tape. Turret sequences for each table position, stop cycle, or other commands are punched at the end of each row. Five digit readings are displayed in both the X row and the Y row—two whole numbers up to 99, and three decimal places—so that each number of the five-place dimension has its own location.

Conversion tables are not required for preparing the tape. Only the decimal information from the part drawing is perforated into the tape, plus punches in areas designated for other machine functions, such as turret indexing. Tapes can be prepared in the shop office by anyone who understands machining operations, at an average rate of one minute per command block. (A command block consists of two lines of punched information, one for the X axis and one for the Y axis.)

Two standard Burgmaster six-spindle turret drills, equipped with the Electropoint system, appear in the heading illustration. To the right of each drill is its console. These machines are installed at the Clark Bros. Co., Olean, N. Y.

A close-up view of a console appears in Fig. 3. On the front of this console, a vertically reading neon display panel indicates the operation in progress and the table position along both X and Y axes to an accuracy of 0.0005 inch. Actual table position, not command position, is indicated, since the console is controlled by numerical measuring converters mechanically coupled to the table lead-screws.

A reader and command unit on the top of the console consists of a rotating drum which holds the tape, shown exposed in Fig. 4. As each drilling operation is completed, the tape can be advanced manually or automatically to bring a new command block under the reader.

Closed-Loop Servo "Zeros in" Table

Within the console, the output of the tape reader and the converters is subtracted by direct digit-to-digit matching. Current steps (position commands from the tape reader according to the difference in error) are generated, and cause the table to move in a direction to match the command until the exact position is reached. Position commands are numerically compared with the position as measured by the lead-screw and converter combination in the table.

The development of a polarity signal causes power of the proper polarity to be applied to the drive-motor which, in turn, rotates the lead-screw in the direction required to reduce the error. Thus the system is a closed-loop servo con-

Fig. 2. Decimal numbers and spindle sequence can be punched manually into the tape in approximately one minute per command block.

Fig. 3. This console shows the actual table position (to three decimal places) and the number of the operation being performed.

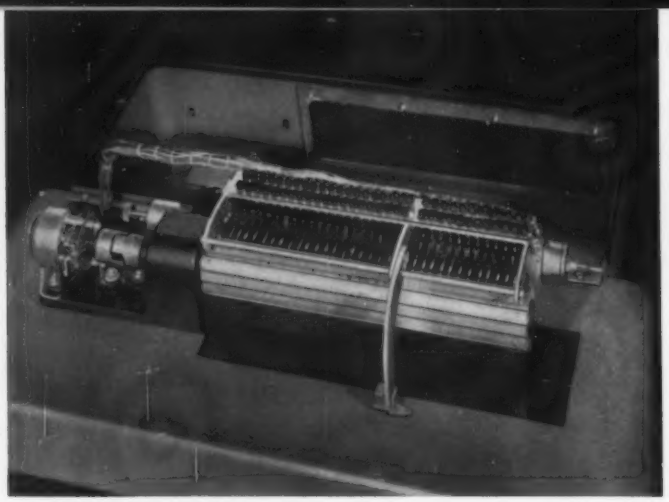


Fig. 4. The tape advances around this reader on the top of the console as each drilling operation is completed.

trol, in that, regardless of the position of the table, the drive-motor will rotate in that direction which will cause the difference between command and table positions to be reduced to zero. The matching is accomplished by transistor switches rather than relays so that an instantaneous comparison and error calculation can be effected.

Both table lead-screws are 5-pitch and of circulating-ball design. Lead accuracy is 0.0005 inch per foot. At one end of each lead-screw is a drive-pulley, and at the other end is the converter. The arrangement can be seen in Fig. 5.

The error voltage from the comparison unit is utilized by the servo control to govern the speed of the drive-motor in such a fashion that little or no overshoot occurs. A Warner electric brake provides a fast stop to table advance. Since the servo control completes the closed loop, the table is always positioned accurately, independent of the direction of approach. Total balancing time is approximately one second.

Once positioned, the table is locked in place by air clamps for the machining operation. The turret-slide is locked out until the table is positioned, after which it will approach rapidly, feed, retract, and index automatically. Feed-stroke for each spindle is controlled by the setting of a micrometer stop on a vertical drum. These stops operate micro switches which, through hydraulic valving, reverse the turret-slide.

Actual machine operation is flexible, there being a choice of four methods: manually, with the tape reader disconnected, for setting up; semi-automatically, employing the tape reader, but under full operator control, for checking out a new tape; automatically, with all functions directed by the Electropoint system, for regular production; or finally, as a standard turret drill under automatic hydraulic control, with the console shut down.

Clark Bros.' experience demonstrates the savings possible with the equipment. One man runs both drills, thus reducing machining time on stop-plate valve parts from ninety-six to twenty-six minutes. The parts are produced in lots of fifty to two hundred. Expensive fixtures, costing approximately $500 each, are eliminated. The tape, prepared in three hours, controls the ma-

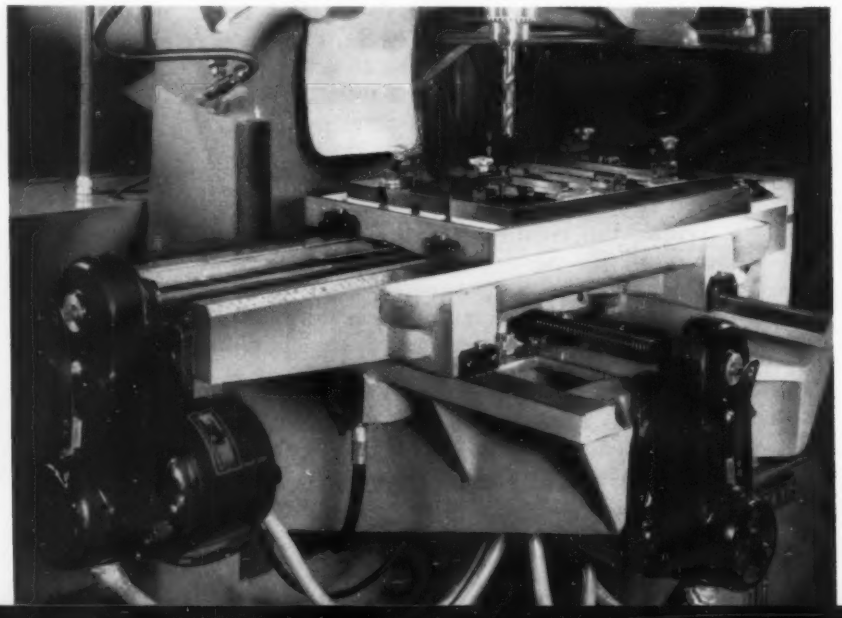


Fig. 5. The lead-screws rotate in anti-backlash ball nuts attached to the table.

chine to keep the center-distance tolerance on the holes within the 0.0025-inch tolerance specified. In addition, the operator has time to inspect parts while the machines are running. The tape is readily stored, and can be re-used indefinitely.

Other advantages are claimed for the Burgmaster Electropoint. The need to use drill and reamer bushings is eliminated. Fixture re-work time, which can consume many hours, can be reduced to just a few minutes by simply placing cellophane tape over the old holes in the control tape and punching in the new data.

Infinitely Variable Speed Drive Delivers Constant Horsepower

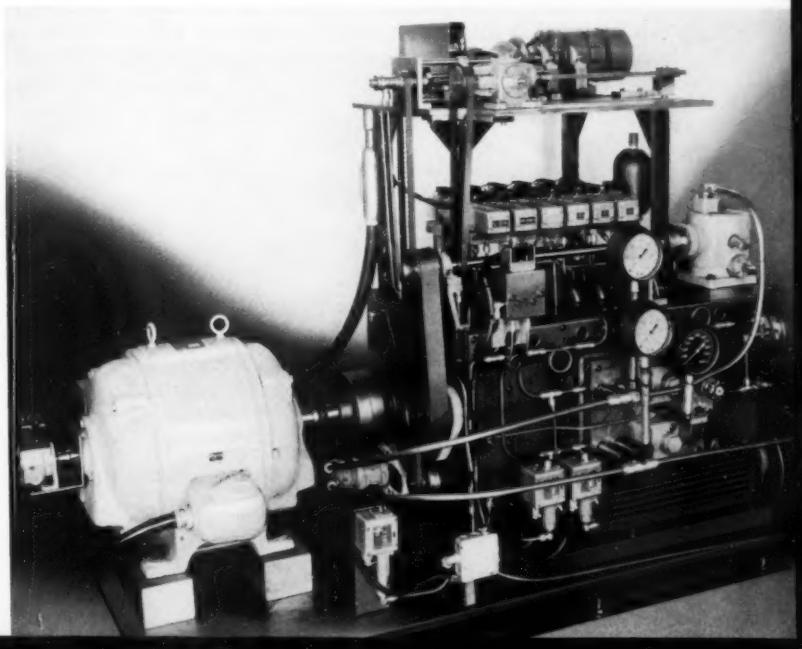
A POWER TRANSMISSION that offers infinitely variable speed output at constant horsepower over a range of speeds having limits in the ratio of 13.5 to 1 has been developed by the Bullard Co., Bridgeport, Conn. While not yet ready for commercial application, the 40-hp, prototype drive, here illustrated, has been used to provide a means for smoothly changing the operating speeds of a vertical turret lathe between 0 and 1800 rpm.

In one test, the face of a large-diameter, steel, disc-shaped part was faced from perimeter to center with a constant cutting speed (sfpm) and at a constant horsepower. The smoothness of speed changes was demonstrated by suddenly reducing the cutting speed to 0 while taking a cut with a carbide tool, and then immediately increasing the speed to 300 feet per minute. No damage to the carbide tool or work occurred. Furthermore, extended overload tests up to 75 hp showed no damage to the transmission. From no-load to full load, even with instant loading, there was no perceptible drop in rotational speed.

In construction, the new drive combines planetary differentials with two small, positive displacement hydraulic units. Basically, the drive is comprised of two planetary differentials interconnected so that during the operation of one, the other is preconditioned to take over the load. While a drive can be built employing this nucleus, the 40-hp prototype has two additional planetary differentials. With this arrangement, three separate but continuous ranges of speed are transmitted to the output shaft.

Hydraulically operated clutches transfer the drive between the differentials. Clutch shifting sequence is controlled to insure the engagement of one clutch prior to the disengagement of another. All shifting takes places with the clutch members synchronized. A servo mechanism insures a positive speed relationship between the hydraulic units and the planetary differentials for shifting. Extensive prony-brake tests show an 87 to 92 per cent operating efficiency for the 40-hp prototype in the range from 130 to 1800 rpm.

For development purposes, an electromechanical control system with solenoid-actuated valves was used for clutch actuation. A compact, purely hydromechanical control system is presently being designed which will require a minimum of electrical equipment.



Infinitely variable drive that delivers constant horsepower over a wide range of speeds. This 40-hp prototype has been successfully applied to a vertical turret lathe.

SHIMS YOU CAN PEEL

for on-the-spot alignment

Accurate fit and alignment can be obtained easily, either in maintenance work or during assembly, by the use of laminated shims. Built up of paper-thin leaves bonded into a solid one-piece structure, these shims can be readily peeled to size with a penknife.

MERLE LOCKWOOD, Vice-President
Laminated Shim Co., Inc.
Glenbrook, Conn.

ACCURATE FITS to a thousandth of an inch can be tailored into an assembly in minutes with no need for the operator to leave the work area. This can be accomplished with Laminum, a laminated shim material produced by the Laminated Shim Co., Inc., of Glenbrook, Conn.

These shims are built up of precision-gage laminations that are held together by a microscopic binder over their entire surface. They form a structure having the appearance of a unit, looking and performing like solid metal. The paper-thin leaves are either 0.002- or 0.003-inch thick, depending on the assembly they are to serve. Therefore, by peeling off one or more layers with the aid of a penknife, fine adjustments can be made at their point of use.

Installed during assembly, Laminum shims act as built-in adjustments to compensate for wear. Peeling off one or more laminations will restore original positioning of gears, bearings, and shafts. This is especially useful in exacting installations of precision and high-speed machinery where looseness can cause vibrations and inaccuracies.

Used Widely in Helicopter Assembly

Precut shims of Laminum are used extensively in helicopter manufacture by the Sikorsky Aircraft Division of the United Aircraft Corporation in Stratford, Conn. In Fig. 1 can be seen an array of typical shim sizes regularly used, the largest being 21 3/4 inches in diameter.

Of all the laminated shims used at Sikorsky, approximately 40 per cent find their way into gear-boxes; 20 per cent into rotor-head assemblies; and the remaining 40 per cent into the assembling of operating control units, landing gear, and servo units. The shims range in di-

ameter from 9/16 to 24 inches. They are used in ten thicknesses, ranging from 0.010 to 0.126 inch. All are built up of 0.003-inch thick laminations with one exception—the 0.062-inch thick shim is used in two forms: all laminated, and half-solid, half-laminated.

Gear-boxes are assembled for each of the three helicopter models being produced (the S-55, S-56, and S-58). These units contain the power-transmission gearing from the engine to both the main rotor-head and the tail rotor. A 21 3/4-inch diameter laminated shim is shown being positioned on the mounting flange that separates the upper and lower sections of the gear-box at the left in Fig. 2. A 15-inch diameter shim can be seen in place on the input assembly to the right of the gear-box.

Size and shape offer virtually no problem. Assemblers can quickly peel off excess layers to achieve proper fitting without the use of a micrometer. Peeling time ranges from one to five minutes, depending on the diameter of the shim and the thickness required. A 0.003-inch thick layer is being peeled from a 5-inch diameter shim in the heading illustration. Fitting of the shimmed tail take-off assembly to the lower gear-box assembly can be seen in Fig. 3.

Aluminum accounts for about 75 per cent of the Laminum used in helicopter production. Selection of this metal plays an important role in the over-all weight factor. Also, between each lamination is a bond covering that protects both the shim and the major parts from electrolytic action.

More on Laminated Shim Construction

Laminum sheets are made up in aluminum, brass, mild steel, and stainless steel. Two types of bond are employed: metallic (solder) which is used for brass and mild steel, and resinous (polyester styrene), for aluminum and stainless steel.

Brass and mild-steel shims are prepared in sheets measuring 8 1/4 inches wide (later trimmed to 8 inches) by 48 inches long. Use of wider material has been limited by the accuracy of the individual rolled sheets. Rolling tolerances are held to plus or minus 0.0001 inch on both 0.002- and 0.003-inch thick laminations, with extremely close edge-to-center variations.

The laminations are first dipped in a cleaning bath to prepare them for bonding. They are then coated and piled in stacks with filler sheets inserted to separate the stacks into groups having the desired number of layers. Each of these piles is placed on a conveyor leading through an oven where the coating is transformed to a molten state.

Still riding the conveyor, the stacks pass between the rolls of a company-built mill, where the laminations are squeezed together and excess binder is forced out. During this operation, careful controls are maintained to achieve the required tolerance and bonding of the laminations.

Build-up between layers is negligible—with shims of 1/16-inch thickness, tolerances are closer than commercial mill standards. The shim stock has a solid fuel and can be machined the same as solid material.

Stainless-steel and aluminum shim stock is made up in panels that are 24 inches wide and 48 inches long. The 24-inch wide coil of lamination material is coated with the polyester styrene binder, passed through a shear and cut into 48-inch lengths, then piled up in groups representing the thicknesses of the laminated panels. These groups are placed on the bed of a platen press.

Both platens are heated by circulating hot water while applying pressure to the laminated stack. After a period of time sufficient for curing the resin binder, cold water is circulated through

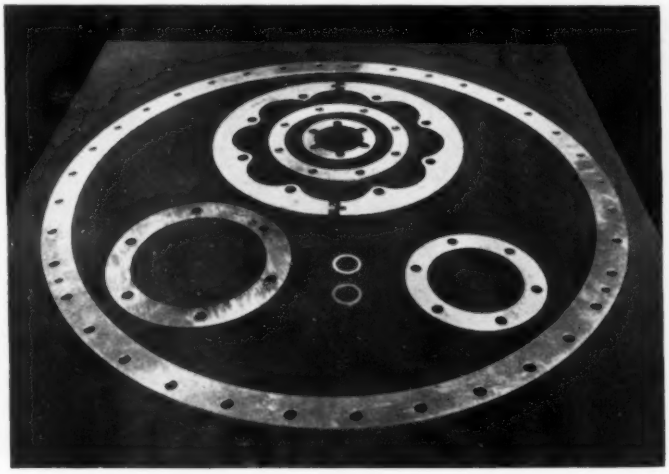


Fig. 1. Representative sampling of the many different sizes of laminated shims that are a part of helicopter assemblies. The shims currently being used range in diameter from 9/16 to 24 inches.

Fig. 2. A 21 3/4-inch diameter laminated shim is being positioned on the mounting flange separating the upper and lower gear-box sections. A 15-inch diameter shim is in place on input assembly (right).

the platens. The laminated shim stock is then removed from the press and trimmed.

A slight build-up is noticed between the resin-bonded laminations, being on the order of 0.0003 inch per layer. In 1/16-inch thick Laminum composed of 0.003-inch thick shim material (twenty-one layers) total build-up is about 0.006 inch.

Some Unusual Applications

There are some out-of-the-ordinary uses for laminated shim stock that are not so readily apparent. In one wing sub-assembly shop a single Laminum shim is peeled to more than one thickness, replacing several single shims. Because the

Fig. 3. After being peeled to thickness as shown in the heading illustration, the 5-inch diameter shim is placed over a tail take-off assembly. Here, the unit is fitted into a lower gear-box assembly.

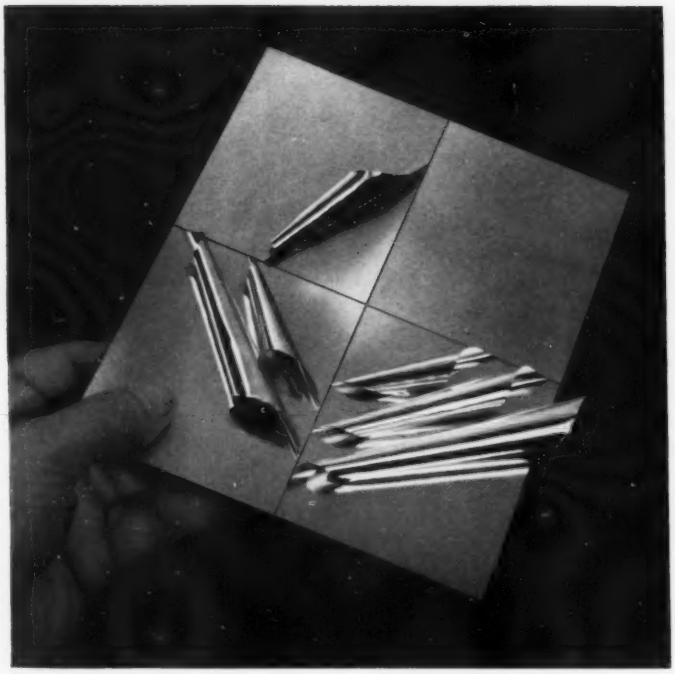


Fig. 4. An unusual application for a laminated shim. To obtain a good fit between two uneven surfaces, the shim has been scored in quarters and a different number of layers peeled from each quadrant.

spar and the diagonal rib are forgings having a manufacturing tolerance of up to 0.060 inch, there are gaps that must be shimmed while in the assembly jig.

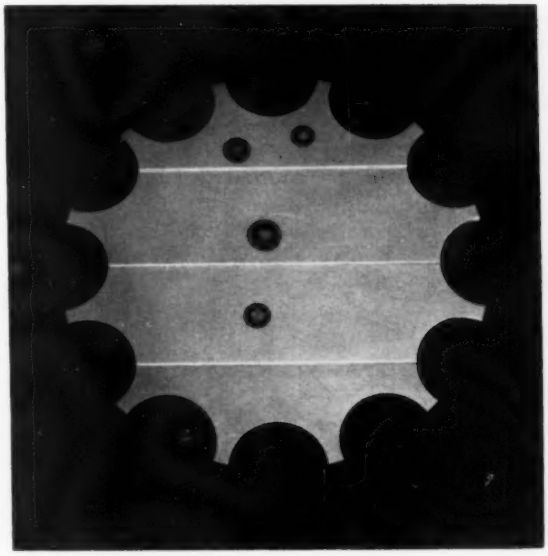
To obtain the best fit, maintaining a conformity to the basic contour line of the structure within a tolerance of 0.010 inch, the shims are adjusted in quarters. First, the thickness required for each quarter of the area to be filled is measured; then the shim is scored into corresponding quarters with a knife. The necessary number of laminations can be peeled from each individual section without disturbing the remaining three sections. As can be seen in Fig. 4, one lamination has been peeled from the upper left-hand quadrant, two from the lower left-hand quadrant, three from the lower right-hand quadrant, and none from the upper right-hand quadrant.

Another unusual type of laminated shim is the tapered one illustrated in Fig. 5. This is not a true Laminum shim in that it is made to do one job only and cannot be peeled to thickness.

Actually, the shim is not tapered at all. Working from the assembly drawing the peripheral contour of the shim is determined, also the degree of taper and thickness needed. Instead of machining a solid piece to contour, then grinding the taper on each unit, the shim is built up in layers.

In the illustrated example four layers are used, each shorter than the next. The first layer is full size, the second layer three-fourths as long, the third layer half as long, and the fourth and uppermost layer only one-fourth as long as the first. All four layers are spot-welded into a solid unit. The point of cut and the thickness of these laminations are so designed that all edges can be joined by a straight line or surface, this line being at the same angle as the desired taper. With only stamping and spot-welding involved, this type of tapered shim can be produced rapidly.

Fig. 5. Paradoxically, this laminated tapered shim is neither tapered nor can it be peeled back. The tapered support is effected across the edges of progressively shorter layers that are spot-welded into a solid unit.

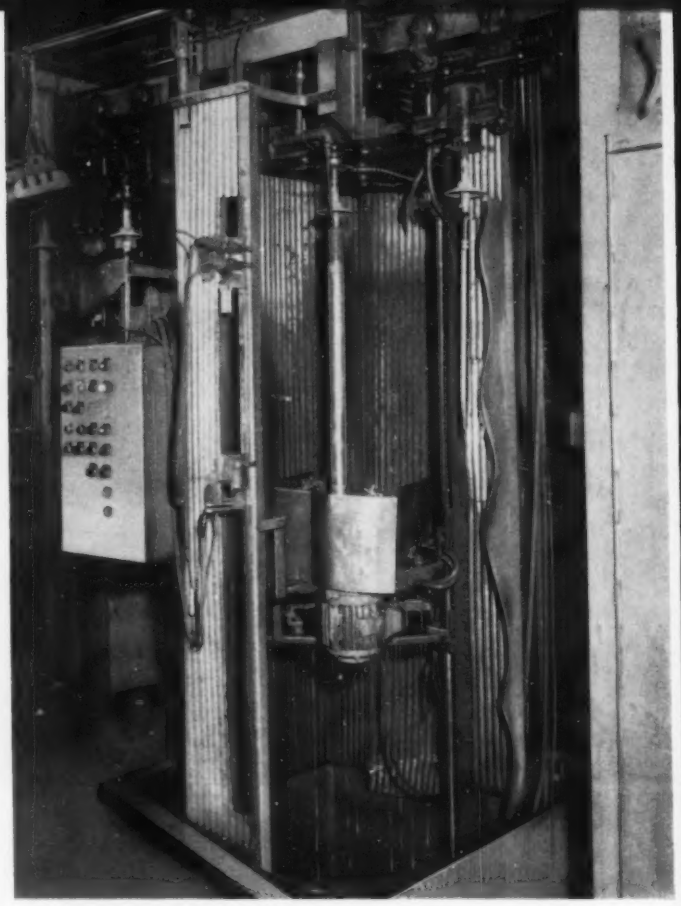


Filtering Out a Production Problem

CONTAMINATION of the coolant used in a belt polishing operation proved costly to the Mission Mfg. Co., Houston, Tex., a producer of special items for the petroleum industry. Cutting oil picked up by the coolant was having detrimental effects on two finishing processes. Installation of a filter in the coolant system solved the problem.

One of the company's products in this highly competitive field is pump rods, made in a variety of types and sizes. Since delivery and manufacture of these rods must often be accomplished in two or three days from receipt of the order, special equipment and considerable automation are required. Designed especially for pump rod manufacture, the vertical polishing machine (Fig. 1) is equipped with a set of fast-moving belts which move up and down the shaft-like work-piece to produce a fine finish. The rods are held vertically, and conveyed successively and automatically through inspection, polishing, and Liquid-Honing stations.

Prior to these operations, the rods are heat-treated and the ends are threaded. Oil and grease used as lubricants in the threading operation remain in the threads as the rods are conveyed through the inspection station to the polishing machine. During the latter operation, the rods are flooded with a soluble coolant which, after becoming contaminated with the grease and oil on the threads, is carried into the tank below. Before installation of the filter, recirculation of the coolant had caused the grease and oil to be deposited on the inside of the polishing machine and on the rods being polished. The polishing belts, in moving up and down the rods, became impregnated with oil and grease, so that their full life was not obtained. Also, the rods carried oil and grease into the next station, the Liquid-Honing operation, subsequently causing contamination of the abrasive.



Realization of the cause of this problem led to the installation of a Delpark filter (Fig. 2) capable of handling up to 10 gallons per minute of the light, soluble coolant. Intermittent flow to the filter is now controlled by the liquid level in the tank under the vertical polishing machine. Coolant is pumped to the filter in cycles varying from the polishing time for one rod up to the time for four rods, depending on their size. The media used by the filter not only remove abrasives and metal particles, but most important, eradicate much heavy coagulated grease and cutting oil.

As a result, the frequency with which the Liquid-Honing abrasive requires cleaning and recharging has been reduced by one-half, and the productive life of a set of belts on the polishing machine has been increased 30 per cent.

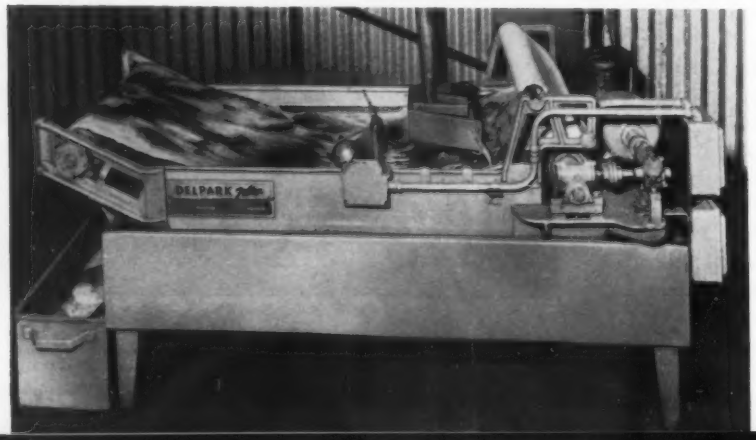
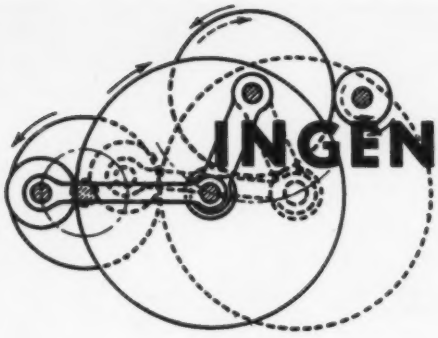


Fig. 1. (Above) Automatic belt polishing machine with pump rod in place. The motor and polishing mechanism move up and down the full length of the rod as it is rotated. Coolant is directed at top of rod.

Fig. 2. (Left) This filter removes cutting oil from the coolant used for the polishing operation. Deposit on the filter is from the contamination.



INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Pitch-Error Compensating Device for Height Gage

J. GILMOUR, Nyack, N. Y.

An unusual height gage, here illustrated, is equipped with an adjustable scale for direct reading and a measuring head that is positioned on the guide column by means of a lead-screw. A vernier, with a dial that is coupled to the lead-screw, permits setting of the instrument to within 0.0001 inch, normally without the use of an optical aid. This accuracy, however, is only made possible by an arrangement that automatically compensates for small pitch errors along the full length of the lead-screw.

The height gage, seen in Fig. 1, has a tubular column *A* (Fig. 2) mounted on a hollow base *B*. A 10-pitch lead-screw *C*, 8 1/2 inches in length, is supported upright inside of the column by a special anti-friction bearing *D* (Fig. 3) attached to the top of the base. The screw thread is of modified Acme form with a root diameter of only 0.190 inch. A plain bushing, lightly pressed in a suitable cap that is screwed on to the top of the column, retains the lead-screw and keeps it in axial alignment.

A measuring head *E* is made a good slide fit on the column and is fastened to a tongue integral with a nut *F* that is a close fit on the lead-screw. For nearly its entire length, the column is provided with a slot 0.200 inch wide to permit passage of the tongue.

Drive for the lead-screw is simply a chain of 50 diametral pitch gears (not shown). There are four gears in all: one is attached to the bottom of the lead-screw; one is an intermediate; and the other two are drivers chosen to give a 2-to-1 speed ratio for rapid traverse, and a 3-to-1 speed reduction for fine adjustment. Setting of the measuring head is accomplished by two knurled knobs protruding from the base of the height gage. A sheet-metal cover *G* encloses the column except for the scale and the slot that provides clearance for the measuring head.

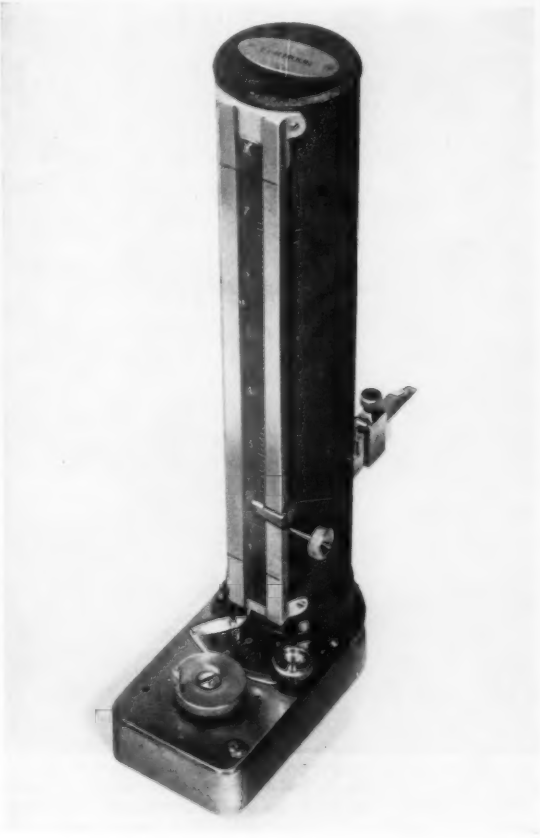


Fig. 1. Unusual direct-reading height gage that has a lead-screw for positioning the measuring head and a pitch-error compensating arrangement.

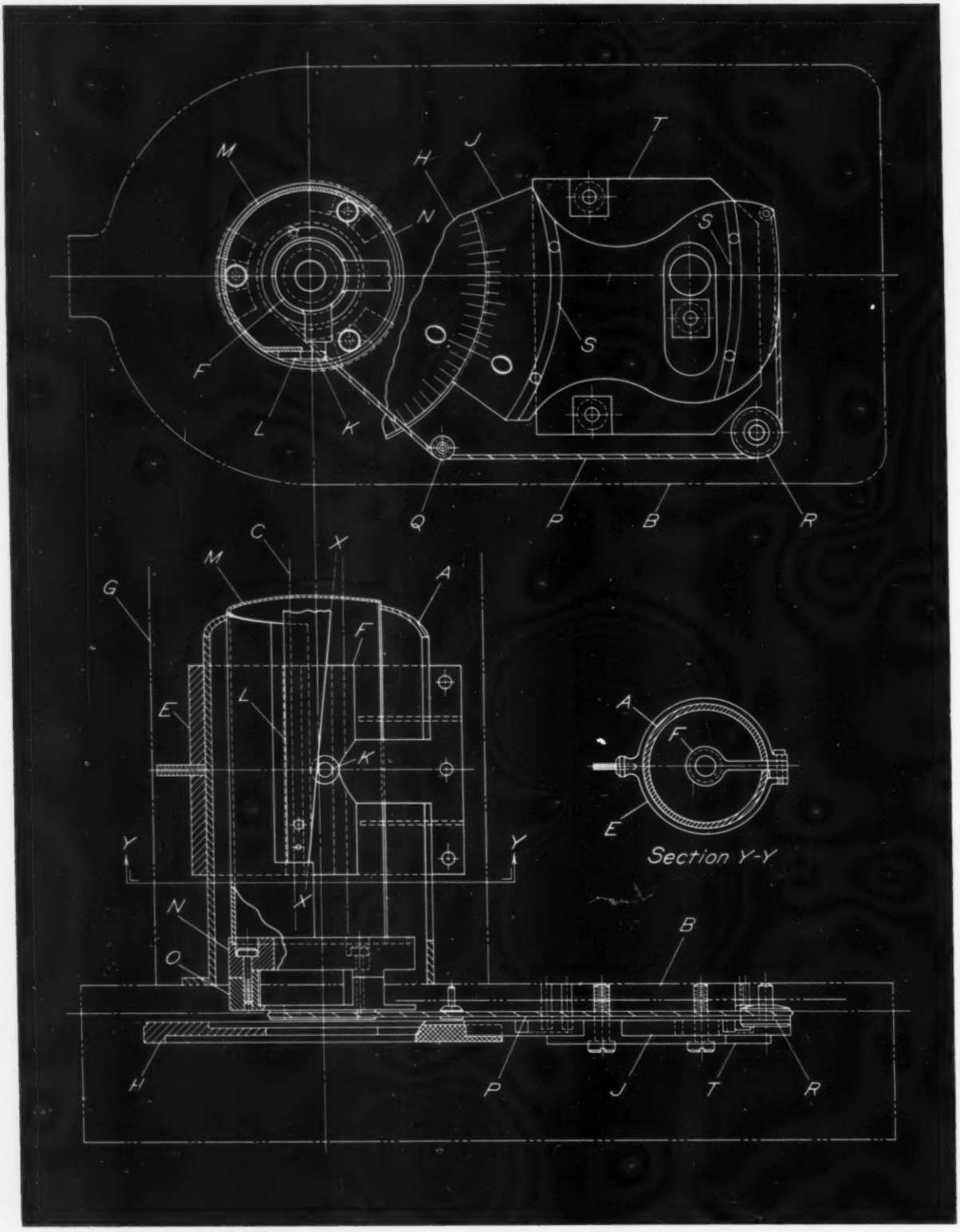


Fig. 2. This mechanism automatically resets vernier scale to compensate for pitch error in the lead-screw of special height gage seen in Fig. 1. For clarity, components not used for this function have been eliminated.

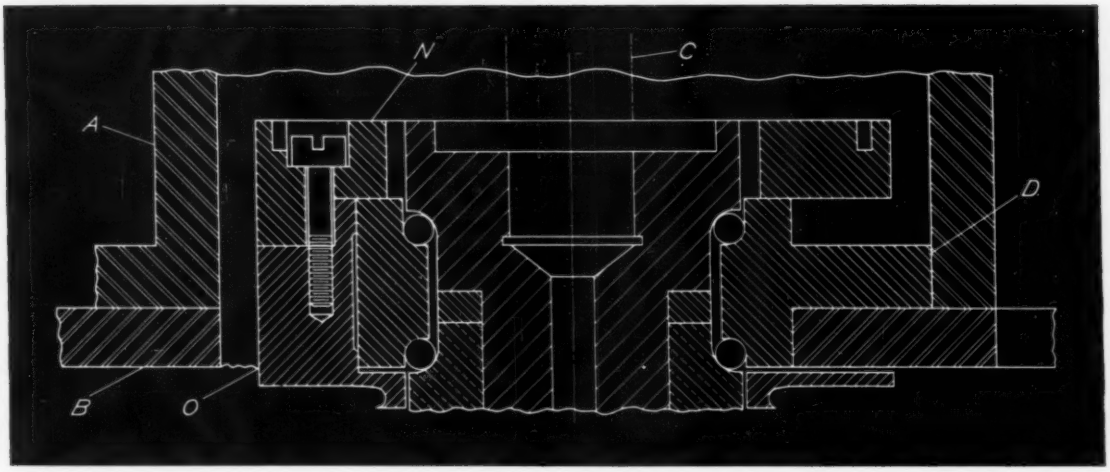


Fig. 3. Enlarged view shows details of main bearing (D) and parts (N) and (O). Outer race of the bearing has a flange that is cut away at three points to permit passage and movement of part (O).

A dial *H*, coupled to the lead-screw, is visible through a window in the base of the gage and is used in conjunction with a vernier scale *J* to set the measuring head. The main scale is adjustable vertically. Also, exerting light pressure on a button on top of the base frees the dial for readjusting to zero and simultaneously locks the lead-screw in place. This arrangement permits the scale and the dial to be quickly and easily set to zero, regardless of the position of the head within its full range of 7 inches. The height gage is, therefore, direct reading, and consequently the usual paper work required for setting the gage is greatly reduced. Downward measurements, although involving subtraction, present no problem since the dial is simply read backwards, as is the micrometer dial on the feed-screws of many machine tools.

Construction of the measuring head is shown in section Y-Y, Fig. 2. The center hole of the three in the tongue of the nut is to accommodate a knurled knob (Fig. 1) for clamping the measuring head to the column. Scriber clamping arrangement (not shown) is attached to the measuring head by means of the stud located opposite the tongue. The accuracy of measurements made with this height gage would normally depend on the accuracy of the lead-screw were it not that the arrangement incorporates an automatic pitch error compensating device. This device advances or retracts the vernier-plate according to the position of the measuring head. Amount and direction of vernier movement are controlled by the contour of a compensating bar. The pitch-error compensating arrangement and associated parts are illustrated in detail in Fig. 2.

Actuating pin *K* is a light drive fit in a boss on nut *F*, and is always in contact with the working edge of compensating bar *L*. The bar is attached to a member *M*, which is made of light tubing. Member *M* stands upright between the inner wall of the column and the screw. Sufficient clearance prevents interference between these parts. The bushing forming the top bearing for the screw also serves as the top pivot for member *M*, the bottom end of which fits in an annular groove in a part *N*. A small screw, not shown, restrains member *M* from turning in the groove. Three screws fasten member *N* to three bosses milled on the upper face of a member *O*. The shape of these bosses may be seen in Figs. 2 and 3. Before assembly, the bosses on member *O* are inserted into openings in the top of the base. These openings surround main bearing *D*, and are shaped as shown to permit members *N*, *O*, and attached parts to have a limited rotational movement.

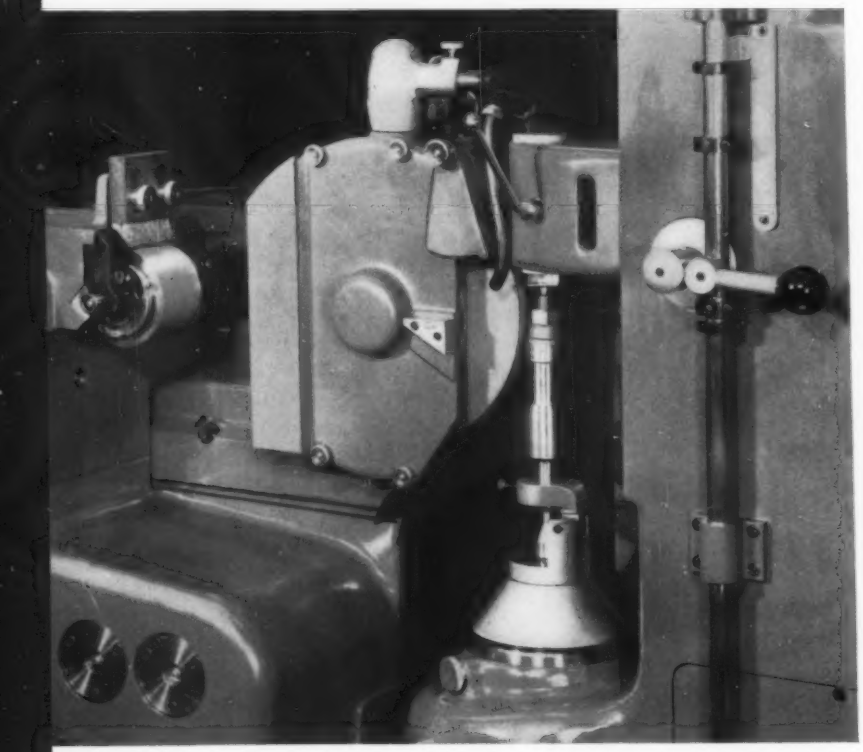
The body of the main bearing fits snugly in a reamed hole in the top of the base and is flanged. Three screws secure the flange to the top of the base. In addition, the flange is cut away the same as the base to allow clearance for the bosses on part *O*. Member *N* rests on the top face of the bearing body which is somewhat higher than the top of the flange. The bosses on member *O* are a free fit on the periphery of the outer bearing race. This arrangement permits members *N* and *O* to straddle the bearing support flange and to rotate a few degrees on the bearing.

A groove of semicircular cross-section is machined into the periphery of member *O* to accommodate a cord *P*. One end of this cord is attached to member *O*, and the other end is attached to

vernier-plate *J*. In addition, cord *P* passes over pulleys *Q* and *R*. Two grooves of rectangular cross-section are cut in the vernier-plate along arcs centered on the axis of the main bearing. These grooves accommodate two phospher bronze guides S of the same radii. Each guide is attached to the base with two 0.063-inch diameter pins that are a light press fit in locating holes. The guides allow the vernier-plate to move in an arc. Retaining plate *T*, held in place with three screws, supports the vernier-plate. A suitable tension spring (not shown) is attached to the vernier-plate to exert a constant pull on the related parts and keep the operating edge of compensating bar *L* in contact with actuating pin *K*. Dial *H* rotates with the lead-screw.

As an illustration, let X-X represent the operating edge of compensating bar *L*. Assuming the measuring head is being raised for a distance of 0.5000 inch, actuating pin *K*, moving with the nut, slides along the bar. Since the bar is inclined in relation to the axis of the column, the sliding action of pin *K* imparts a clockwise movement to members *M*, *N*, and *O*, and the pull of the cord advances the vernier accordingly. Advancement of the vernier is necessitated by the fact, previously established, that a little more than five turns of the 10-pitch screw is required to raise the measuring head exactly 0.5000 inch. If the vernier remained stationary, the zero on the dial would be slightly ahead of the zero on the vernier. Disregarding the pitch error and coinciding the zeros of the dial would, of course, result in a false setting. This has been avoided by the automatic adjustment of the vernier-plate setting.

Finding the pitch errors of the lead-screw and bringing the compensating bar to the desired shape are simple undertakings carried out at the time of assembly. Pitch errors are first ascertained by recording the dial readings of the gage when measuring the height of gage-blocks. Then the compensating bar is detached from the easily removed member *M* and is filed to a shape that will automatically position the vernier scale for accurate readings. Since the back edge of the bar is straight, the contour may be easily measured with a 1-inch micrometer. A contour filed to within plus or minus 0.001 inch of the desired shape will meet practical requirements, for movement of the pin *K* in relation to the change in the reading on the vernier scale of the height gage is in the ratio of over 50 to 1.



A 200 - pitch, 20 - degree pressure angle, 96-tooth gear is being generated on this Sheffield-Matrix fine-pitch gear grinder at Bendix Aviation's Eclipse-Pioneer Division, Teterboro, N. J. The tiny gear, part of a missile instrument train, is believed to be the finest pitch ever ground. The grinding wheel is similar to a large-diameter hob or worm, and has the basic rack form crushed into its periphery by the small roll seen to the left.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Spring-Actuated Taper Attachment

JOSE SOBKOWIAK, Jackson, Mich.

Spring tension controls the action of a simple taper attachment that can be constructed for practically any lathe. By substituting a different follower, the device is easily adapted to use as a contour tracer. Plan and end views are shown in Figs. 1 and 2 (view W), respectively.

Platform *A*, of right-angle construction, is attached to the rear of the lathe carriage. The top surface of the platform is level with the top of dovetail *B* of cross-slide *C*. Guide *D* is doweled and screwed to the outer edge of the platform, and is parallel to the lathe ways. The chip guard of the cross-slide was removed, and the cross-slide was released from its feed-screw nut.

Bridge-piece *E* (see Fig. 2, view X, for detail), fastened to the end of the cross-slide, has a channel on top which supports one end of link *F*. The other end of the link extends across the platform. The link is a snug fit in the bridge-piece, and is secured by spring-holder *G*. There is a slot through the link, made long enough to permit full travel of the cross-slide.

Post *H*, passing through the slot and contained in a hole reamed through the platform and guide, has a tension rod *J* hooked to the outer end of spring *K*. Adjustment of the spring is made by loosening clamp *L* and twisting handle *M*. Shoulder section *N* of the post is slightly longer than the height of the link and slightly smaller in diameter than the width of the slot.

Follower *P* (see Fig. 2, view Y, for detail) is kept snugly against template *Q* by the spring tension. The follower is engaged by threaded pin *R*, which in turn is screwed into bolt S fixed at a point in the slot by lock-nut *T*. Flats are milled on opposite sides of the bolt where it bears in the

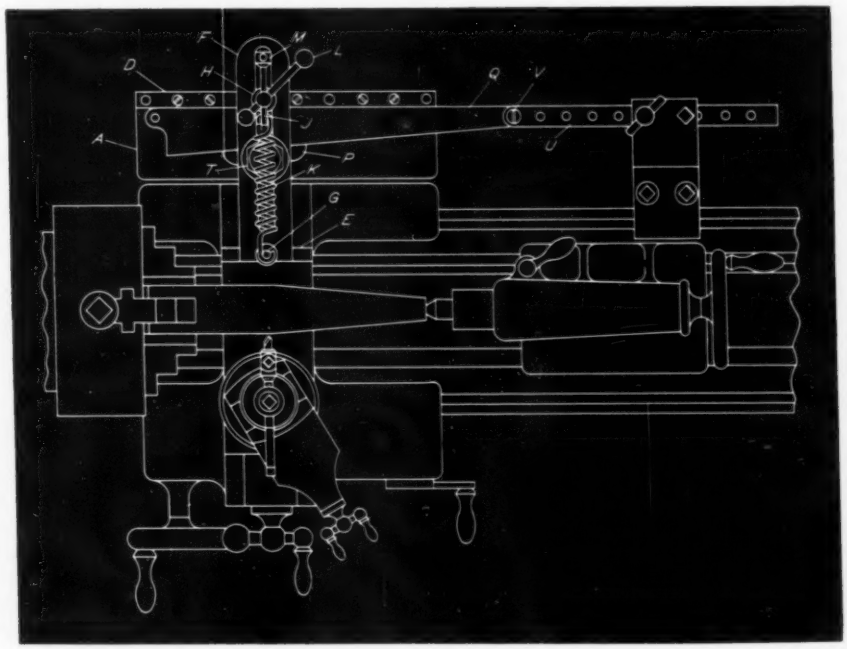


Fig. 1. When the carriage feeds toward the spindle, follower (P) is forced back as it moves along the edge of template (Q).

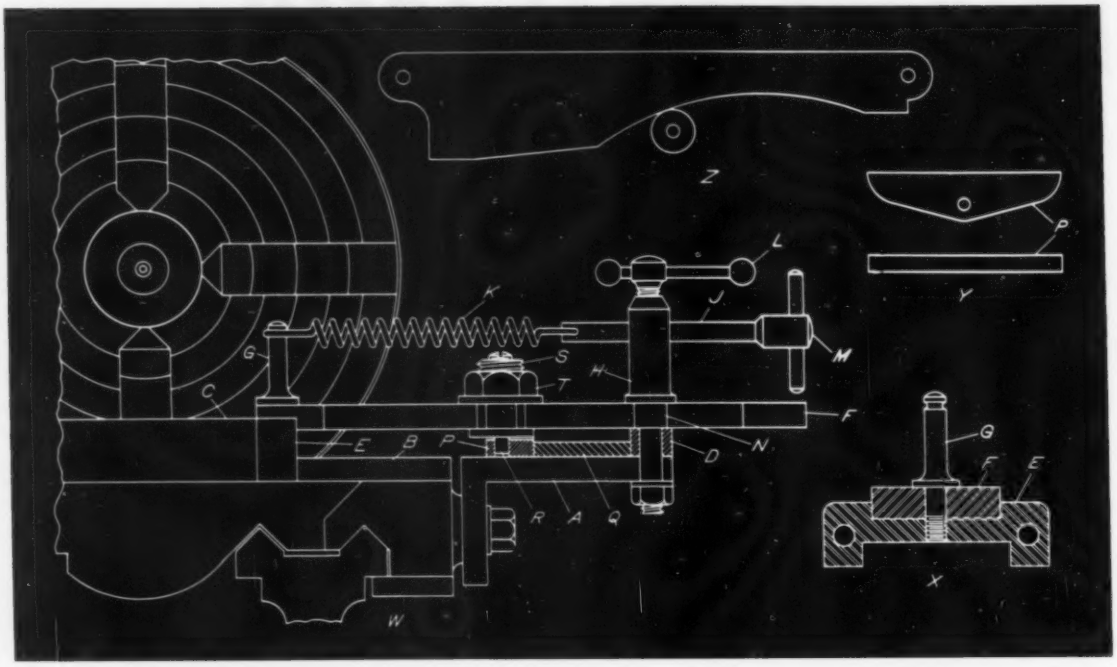


Fig. 2. In end view W can be seen how the strength of spring (K) is adjusted through handle (M). Views X and Y show the design of bridge-piece (E) and follower (P), respectively; and view Z shows a typical follower and template for contour tracing.

slot, so that it can be moved easily when the lock-nut is loosened.

The template is made from flat stock of a suitable thickness to clear the opening between the link and the platform. Taper of the template is one-half that of the work. For example, to produce a taper of 1/2 inch per foot, the template taper is 1/4 inch per foot.

At its right end, the template is anchored to an extension bar *U* which is clamped to the lathe bed. Linkage between the template and extension bar is through a shouldered screw *V*, which permits any needed swivel of the template for alignment. There is a hole tapped in each end of the template to receive this screw, so that the same template can be reversed and used to produce an opposite direction of taper in the work.

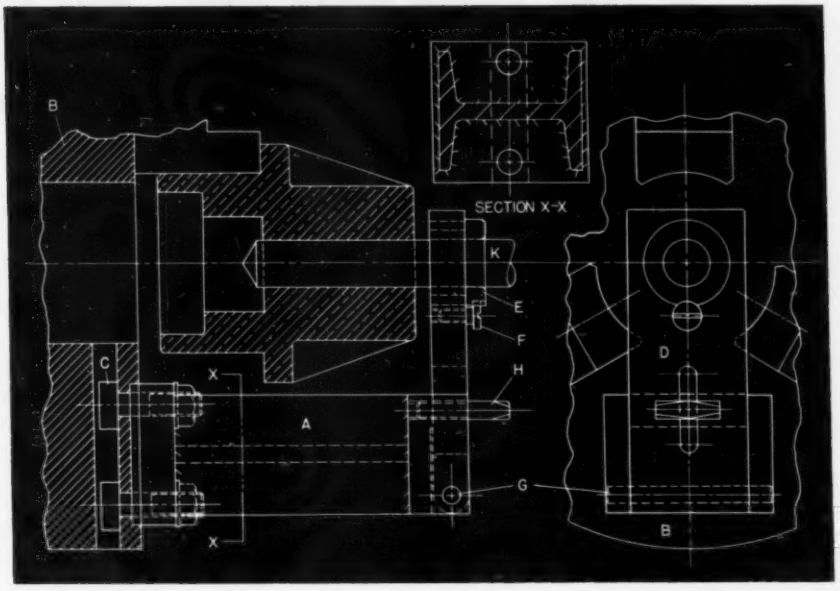
When setting up the job, lock-nut *T* is loosened and the cross-slide is positioned with the cutter close to the work. Then the lock-nut is tightened and final adjustment of the cutter made by advancing the compound rest. In operation, the follower moves along the edge of the template, which is stationary, and the cross-slide backs the tool away from the work as the carriage feeds toward the spindle. For tracing a contour, a roller type of follower and suitable template are substituted, as can be seen in Fig. 2, view Z.

Chuck-Mounted Bushing Facilitates Deep-Hole Drilling

ROGER ISETTS, Kenosha, Wis.

When drilling deep holes in work-pieces that are chucked in a turret lathe, the drill, if unsupported, may wobble and chatter. This condition can be eliminated or greatly reduced by means of a support bushing that is bracket-mounted to the lathe chuck. The arrangement here illustrated is particularly designed to steady and guide long drills of the larger sizes.

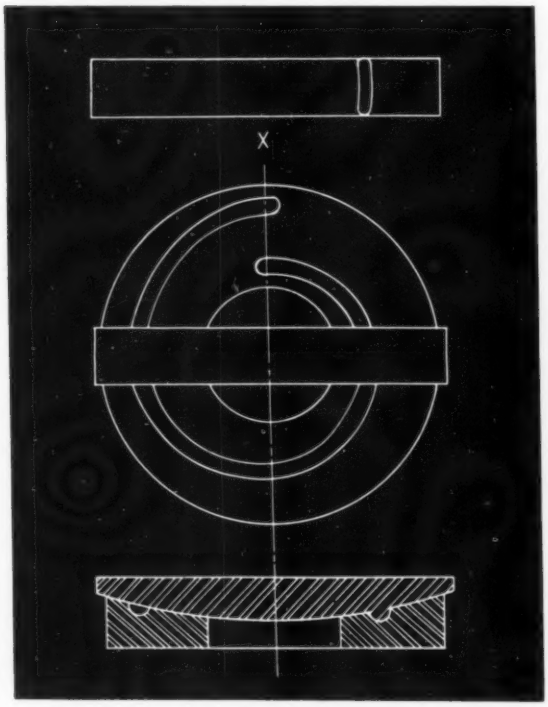
Bracket *A* is of welded construction. A steel bottom plate is welded to a length of standard I-beam and another plate is welded to the top. After normalizing this weldment, a key is machined in the bottom to fit the T-slot in the chuck *B*. Two holes are then drilled for the T-bolts *C* which secure the bracket in place. A slot is milled in the top of the bracket to receive a swinging



Long drills can be guided and steadied by a bushing that is bracket-mounted to the lathe chuck.

bushing plate *D* made of cold-rolled steel. In addition, the bushing plate is bored to receive a standard liner for a fixed renewable drill bushing *E*. Different drill sizes can, therefore, be accommodated simply by changing bushings. Lock screw *F* prevents the bushing from rotating.

A cross-hole is reamed through both the bushing plate and the bracket for a standard dowel *G*. This dowel acts as the hinge for the swinging bushing plate. Quarter-turn thumb-screw *H* is provided to hold the bushing plate in the operating position. For clarity, the work-piece is not shown in the right-hand view. When using a large-size drill *K*, the speed required may not be high enough to make counterbalancing of the chuck necessary.



Non-Slip Lathe Toolpost

S. P. Gould, Porterville, Calif.

Lathe toolposts support the tool-holder over a ring and rocker. The top of the ring is concave and forms a seat for the rocker, which has a convex bottom. There is an oblong space in the toolpost above the rocker to receive the tool-holder.

With this construction, the tool-holder can be horizontal or at a slight incline, toward or away from the spindle center line, to adjust the height of the tool. One drawback, however, is that under a heavy infeed cut the rocker might slip back on the ring and the tool-holder will then work loose.

To avoid this, a spiral groove is end-milled in the top of the ring and a curved lug is welded to the bottom of the rocker, as in the illustration. Twisting the ring in one direction will raise the tool-holder, and in the other direction, lower it. The positive engagement of the lug with the groove will counter the cutting thrust.

The lug in the groove prevents slippage between the rocker and ring.

MATERIALS

The properties and new applications of materials used in the mechanical industries

Heat-Treatable Cast Steel for Punches and Dies

A heat-treatable cast steel for punches and dies has been introduced by American Foundry & Machine Division of the Eimco Corporation, P.O. Box 300, Salt Lake City 10, Utah. "Utaloy Die Steel," as it is called, is said to overcome the principal limitation of cast steel as a die material since its composition and heat treatment provide the necessary gall resistance. The steel has a consistent critical hardness of 60 to 62 on the Rockwell C scale and was developed to replace more expensive forged steels.

Greases for Lubricating Bearings at 600 Degrees F.

Greases with an operating temperature range of from minus 45 degrees F. to plus 600 degrees F., which were developed to meet the high-temperature lubrication requirements of supersonic aircraft and missiles, have been announced by the Shell Oil Co., 50 W. 50th St., New York 20, N. Y. Designated "Grades ETR Grease B and ETR Grease D," the greases are water-resistant, stable, and have an extremely low evaporation rate. A silicone fluid is used as a gelling agent for these greases because it possesses the required volatility, oxidation stability, and viscosity-temperature characteristics.

Large Sizes of Nylon Plate Made Available

The availability of nylon plate in thicknesses of 1 1/4 to 1 1/2 inches has been announced by The Polymer Corporation of Pennsylvania, 2140 Fairmont Ave., Reading, Pa. These thicknesses are available in the "Polypenco Nylon 101" and "Polypenco Nylatron GS" (molybdenum disulphide filled) formulations in standard widths of 10 inches and in lengths ranging up to 4 feet.

This plate exhibits high wear resistance and resilience, low surface friction, non-galling characteristics, and sound-deadening properties. It has been used for such applications as wear liners or pads, stripper knives or scraper blades, and equipment slides. It is readily machined on milling machines and shapers.

Silicone Fluids for Use as Damping Mediums and Hydraulic Fluids

Three grades of water-clear "General Electric Fluid 81743" have been made available by the Silicone Products Department of the General Electric Co., Waterford, N. Y. The differences in these grades are their viscosities, which are 5, 10, and 20 centistokes. These fluids may be used as damping mediums in vibration dampers, shock absorbers, dash-pot and timing relays, and as hydraulic fluids in servomechanisms, accelerometers, instruments, and other control devices. They are highly resistant to shear breakdown and possess unusual chemical resistance. Because of their low viscosity, they offer somewhat more rapid response than the other silicone fluids of higher viscosities.

Aluminum Die-Casting Alloy Exhibits Structural and Bearing Strength

An aluminum die-casting alloy, called "Alcoa Alloy X385," which will permit integral bearing surfaces instead of cast-in or specially assembled bearings or bushings in aluminum die-casting designs, has been made available by the Aluminum Company of America, 1501 Alcoa Building, Pittsburgh 19, Pa. When used in revolving- or sliding-bearing applications, this material will withstand pressures of 1500 pounds per square inch. The tensile and yield strength on a typical specimen are 36,000 and 20,000 pounds per square inch, respectively.

The tin, lead and cadmium in the alloy provide for a combination of good casting characteristics, mechanical properties, and bearing qualities. These elements also provide good machining characteristics. The alloy has been used for connecting rods in air-conditioning compressors, and

will be used for connecting rods in refrigerator compressors and outboard motors, housings in washing machine and dryer gears, and parts in electric hand tools.

Non-Flammable Adhesive for Bonding Porous Materials to Metal

The development of "Metex," a non-flammable adhesive for bonding leather, wood, fabric, paper, felt and other porous materials to metal, has been announced by Adhesive Products Corporation, 1660 Boone Ave., New York 60, N. Y. The material is applied by spray, brush, or roller-coating machine. The resulting bond is permanently flexible, which makes it possible to bond these materials to metal before forming. Uses include the covering of radio and television cabinets with leather or decorative fabrics.

Multiple-Use Casting Resin Available in Several Formulations

A casting resin which is available in several formulations for various uses is being produced by the Marblette Corporation, 37-31 Thirtieth St., Long Island City 1, N. Y. This material, which sets at room temperature, also lends itself to a combination of a room temperature and short oven cure. Called "Maraset Resin #639," it is odorless, dimensionally stable, resistant to chemicals, and has good recovery characteristics. It adheres firmly to plastics, metals, ceramics, glass laminates, and other materials.

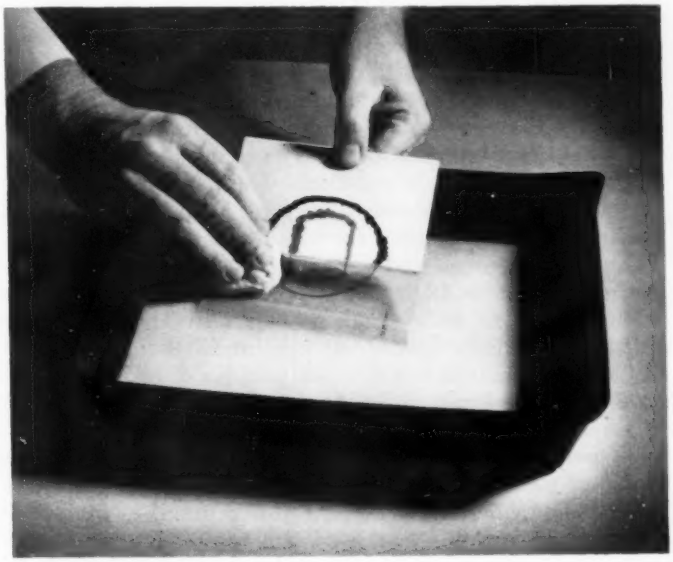
The resin is available in four blends with appropriate hardeners. Formulas 1 and 2, which have a tensile strength of from 300 to 600 pounds per square inch and an elongation rate of from 45 to 60 per cent, are used for gasketing and mold-making applications. Formulas 3 and 4 have tensile strengths up to 2000 pounds per square inch and elongation rates of 55 and 38 per cent, respectively. Formulas 2, 3, and 4 have been employed to face drop-hammer dies for multiple stamping of metal panels. All resins have a high dielectric strength.

Oil That Prevents Water Spotting of Polished Metal Parts

A rust-preventive oil which combats water spotting of highly polished, machined metal parts after alkali or emulsion degreasing and rinsing, and after water-cooling, has been introduced by Octagon Process, Inc., 33 Bank St., Staten Island 1, N. Y. "Froil," as it is called, has a neutralizing action which prevents corrosive attack due to fingerprints and general shop soil. Applications may be made by dip immersion or by spraying, and in some cases by wiping or brushing. Its effectiveness is said to last for months. Parts which may be treated include precision parts, dies, tools, instruments, and gages.

Plastic Material Facilitates Making of Comparator Chart-Gages

Comparator chart-gages can now be produced in any shop by using a plastic material presented by Optical Gaging Products, Inc., Rochester, N. Y. This material is 0.050 inch thick and is called "Fast-Line." Chart-gages are prepared on it by scribing the desired layout using elementary



The optical comparator chart-gage material shown in the tray facilitates the making of professional-like quality chart-gages for all makes of optical projectors. This plastic material is a development of Optical Gaging Products, Inc., Rochester, N. Y.

layout tools or scribing equipment. The scribed lines are then brushed over with a special dye-like fluid. After dipping in a wash to remove excess fluid and the scribe coating, the chart is wiped dry with a cloth or sponge and is then ready for use in an optical projector.

The material is stable with respect to temperature and humidity changes and is rated next to glass as a chart layout material. It comes with either a clear or matte surface in sizes to fit all makes of optical projectors.

Brazing Stop-Off Material Acts as Parting Compound

To prevent the brazing of not-to-be-brazed mating surfaces during furnace brazing operations the Stainless Processing Division, Wall Colmonoy Corporation, 19345 John R St., Detroit 3, Mich., has developed "White Stop-Off"—a material that acts as a parting compound. This material is supplied in powder form and when used is mixed with a volatile plastic called Nicrobraz cement to facilitate application. It may be applied by brushing, dipping, or spraying. The residue which remains after brazing is removed by air-blasting or brushing.

Sintered Metal Ceramics for High-Temperature Applications

A group of metal-ceramic materials have been made available by the Haynes Stellite Co., Kokomo, Ind. These cermets have good high-temperature mechanical properties and high resistance to corrosion over a wide temperature range. They are made by casting to shape, sintering, and machining or grinding as required.

"Haynes Metal Ceramic LT-1," the first of these cermets, has a nominal composition of 77 per cent chromium and 23 per cent aluminum oxide by weight. This cermet resists corrosion, especially that due to oxidation; maintains its strength at high temperatures; has wear and thermal shock resistance; is non-ductile; and can be machined, using tungsten-carbide tools at speeds and feeds normally suitable for cobalt-base alloys. It can also be ground and honed. Its Rockewll C hardness of 32 to 42 is more indicative of its crushing strength rather than its hardness. The individual particles have greater hardness than that of the combined body and give good resistance to wear under sliding friction.

"Haynes Metal Ceramic LT-1B," another of these cermets, is basically the same at LT-1, except that part of the chromium is replaced by molybdenum, and a small amount of titanium dioxide has been added to the ceramic phase. Its nominal composition is: chromium, 60 per cent; molybdenum, 19 per cent; aluminum oxide, 19 per cent; and titania, 2 per cent by weight. Although it has a greater strength and higher hardness than LT-1, its oxidation resistance is slightly less, but its thermal shock resistance is slightly greater. This cermet is machinable with the harder grades of tungsten-carbide tipped tools. It can also be ground, preferably dry.

"Haynes Metal Ceramic LT-2," the last of these cermets, is a tungsten modification of LT-1 with the metal phase rich in tungsten. Nominal composition is: tungsten, 60 per cent; chromium, 25 per cent; and aluminum oxide, 15 per cent by weight. Its bending strength and hardness are greater than for LT-1 and its erosion and abrasion resistance are also high. It is machinable with the hardest grade of tungsten-carbide tipped tools and can be ground, preferably with diamond wheels.

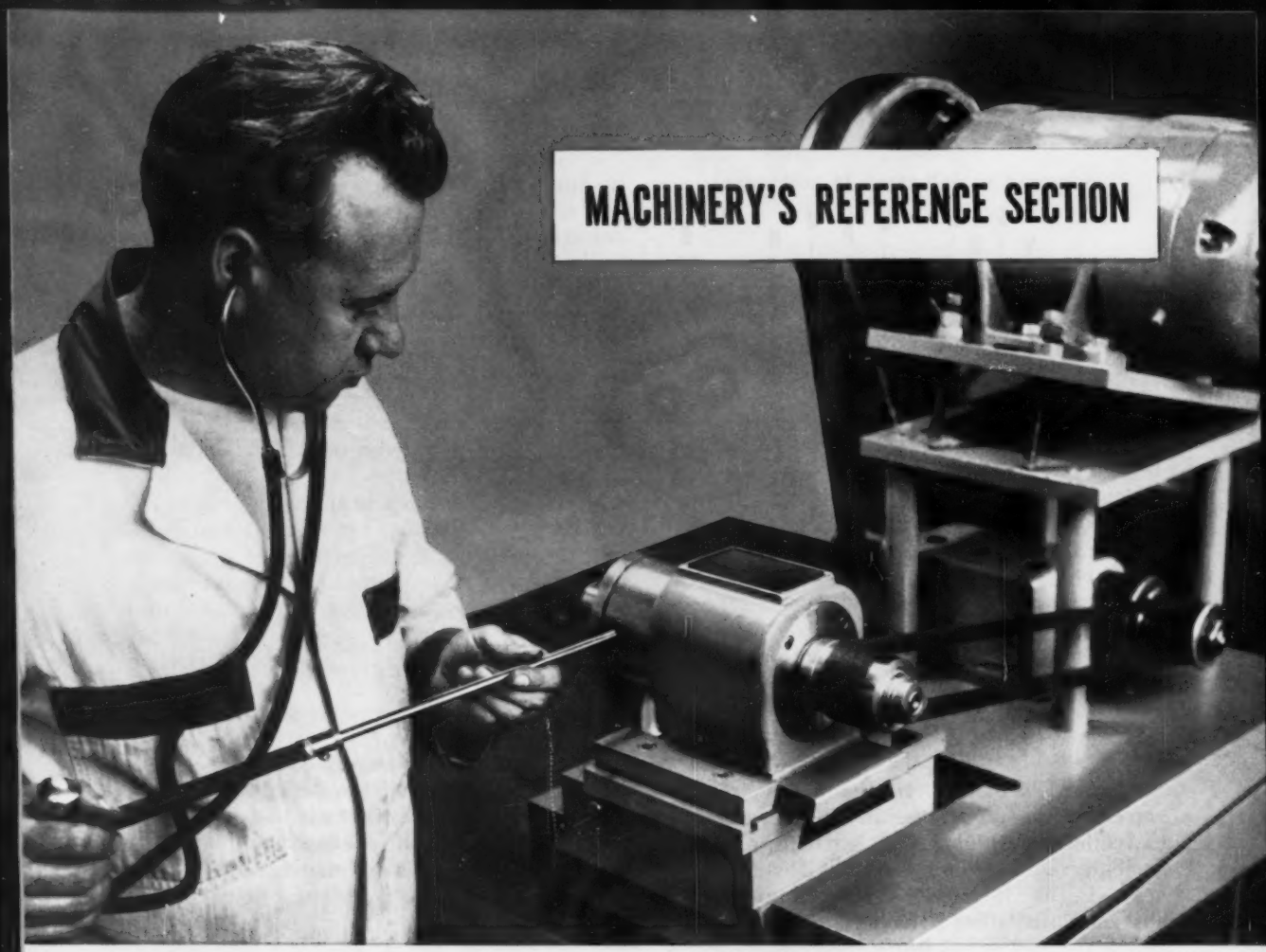
Uses of these cermets include thermocouple protection tubes, and valves for very high temperature applications, such as molten metals. This material is being used experimentally for rocket nozzles on guided missiles.

Abrasive Finishing Compound That Promotes Fast Deburring

A fast-acting abrasive finishing compound used for tumbling ferrous as well as non-ferrous metals and alloys has been made available by Lord Chemical Corporation, 2068 S. Queen St., York, Pa. This mild, relatively soft abrasive powder is especially recommended for the softer metals. However, it is also used for light deburring or cleaning of harder materials. It may be used with any chemically inactive media or in the self-tumbling of suitable parts. The material removes films or skin on die-cast parts and similar workpieces. Its designation is "Lorco 3X."

Two Carbides for Cutting Ferrous and Non-Ferrous Materials

The manufacture and marketing of two low-cost carbides for cutting steel, cast-iron, and non-ferrous materials has been presented by Newcomer Products, Inc., Latrobe, Pa. The carbide for cutting steel is called "NewPro Grade S-35" and that for cutting cast iron and non-ferrous materials, "NewPro Grade C-35." The materials are stocked in standard sizes and styles of triangular and square "Throway" type inserts for mechanical tool-holders, and in triangular and square "Throway" milling machine insert cutters. Rough-molded blanks of many shapes and sizes, standard and special, can be furnished.



Maintenance of Ball Bearings on Machine Tool Spindles

RONALD W. MORAN, Engineering Manager, Precision Applications
Fafnir Bearing Co., New Britain, Conn.

MACHINE TOOLS must meet the ever-increasing demands of modern industry for faster speeds, greater accuracy, smoother finishes, and higher production rates at minimum cost. Such considerations are primarily influenced by the machine tool spindle with its super-precision ball bearings; and the machine tool builder, the spindle maker, and the ball bearing manufacturer are all making great advances in the achievement of these goals.

The machine tool spindle is expertly designed. It is fabricated from the best materials and with utmost care. Quality and accuracy of machining and the rate of production depend largely on the ball bearings that support the spindle. Spindle maintenance and servicing have become a matter of prime importance and should be done only by expert assemblers in meticulously clean, well-lighted, and constant temperature surroundings.

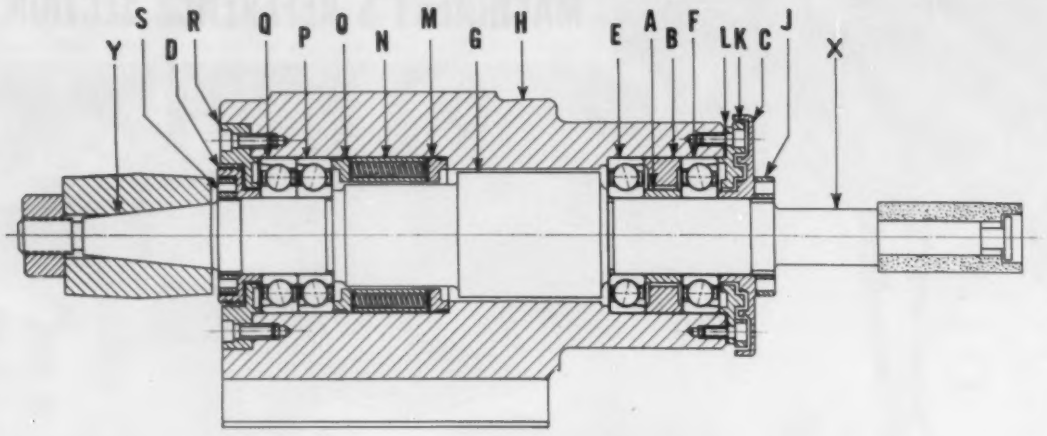


Fig. 1. Spindle of this belt-driven, precision grinding wheel-head is mounted in two pairs of duplexed, angular contact ball bearings. Bearings are pre-loaded and permanently grease lubricated.

This article outlines the basic principles involved in the proper maintenance of machine tool spindles. Although the servicing of a permanently grease-lubricated belt-driven wheel-head (Fig. 1) is described, the mounting methods and installation procedures are typical for almost all types of ball-bearing spindles.

Ball bearings operated at high speeds eventually wear out. For example, consider the case of a wheel-head driven by a high-frequency motor, oil-mist lubricated, and revolving at 80,000 rpm. The inner-ring ball track of the bearings on this equipment travels over 350,000 miles in about six months of operation, or approximately a distance equal to fifteen times around the earth. In 3000 hours of service it would travel a distance equivalent of that to the moon and back.

Manifestations and conditions that indicate or lead to the necessity of ball-bearing replacement are:

Out-of-roundness of work;
Impossibility of maintaining part tolerance;
Existence of noise and chatter;
Production of rough or poor finishes;
Accidental damage to machine spindle;
Accidental "brinelling" of bearings;
Entry of coolant or other contaminant into bearings;
Faulty lubrication of bearings.

Before a spindle is removed from the machine, a check should be made to ascertain whether the

Table 1. Typical Applications of Ball Bearings to Machine Tool Spindles

Application	Bearing Bore, mm	Speed Range, rpm	Lubrication	Approximate Operating Temperature, Degrees F.
Cylindrical and Internal Grinders				
Wheel-Heads				
Belt Drive	17-50	10,000-40,000	Oil mist-grease	100-120
High-Frequency Motor Drive	8-50	10,000-100,000	Oil mist	95-120
Work-Heads	Wide range	Low-medium	Grease	95-110
Surface Grinder	Wide range	1800-5000	Grease	110
Tool and Cutter Grinder	20-35	5000-10,000	Grease	100-115
Gear and Thread Grinder	60-80	3000-5000	Grease	100-115
Boring Heads	Wide range	50-8000	Grease	105-120
Jig Borers	25-75	Up to 3000	Grease	85-100
Lathes	Wide range	Up to 10,000	Oil-grease	100-120
Drilling Machines	15-40	5000-30,000	Oil-grease	100-115
Milling Machines	Wide range	Up to 6000	Oil-grease	100-115
Routers	20-60	12,000-30,000	Oil mist	110-125

trouble is with the spindle, or is the result of improper tooling, roughness in the machine slides, irregular feeds, or some other such cause. Typical applications of ball bearings to machine tool spindles are listed in Table 1. Application, bearing bore size, typical speed range, type of lubrication, and approximate operating temperature are given.

Enclosed Dust-Free Working Area Advisable

The desired results in the maintenance of machine tool spindles are achieved by an experienced mechanic working in a well-organized, clean, and enclosed area set apart from manufacturing processes or machines that propagate dust-laden air. His work-bench and tools are clean and maintained in good working order. His surface plate is equipped with bench centers or parallel V-blocks and weighted end block, and test gage-blocks with 0.0001-inch dial indicators. He is equipped with outside and inside micrometers, a hole gage with 0.0001-inch indicator, a comparator gage with 0.0001-inch indicator, and master discs and rings or precision blocks.

To insure dimensional accuracy and proper fitting of the spindle parts and ball bearings, all checking and assembly operations should be performed with gages, parts, and bearings that have attained a constant temperature. The equipment and all the parts to be assembled should be held in the working area long enough for them to assume thermal equilibrium before any measurements are taken.

Inspection of Parts Before Assembly is Important

The ideal shaft bearing seat is accurately and smoothly ground and absolutely free from burrs, tool marks, and rust. An indicator gage that reads to 0.0001 inch is used to check the bearing seat. This gage is set to the basic diameter with a master disc or with precision blocks. Deviations from the standard dimension are indicated by rolling the shaft backward and forward in several positions, and an axial movement of the bearing seat under the indicator gage registers any taper.

The spindle shaft, with a steel ball located in one of its centers, is then mounted on parallel V-blocks and held against a weighted end block (Fig. 2). Bench centers may be used, provided the shaft centers are free of damage and true. With the dial indicator seen at the left set at zero and contacting the bearing seat, the shaft is revolved slowly to determine runout and straightness. Both seats should be true with each other within 0.0002-inch total indicator reading, and within 0.0001 inch for very high-speed spindles. The wheel end and pulley taper of the shaft are checked, and if the runouts do not coincide with their respective bearing seats, the high points of eccentricities are marked for identification. With the dial indicator seen at the right in Fig. 2, the squareness of the bearing shoulders on the shaft is ascertained. This runout should not exceed 0.0002-inch total indicator reading.

The housing bore is checked with a two- or three-point hole gage which is set to the basic diameter with a master ring, or with precision

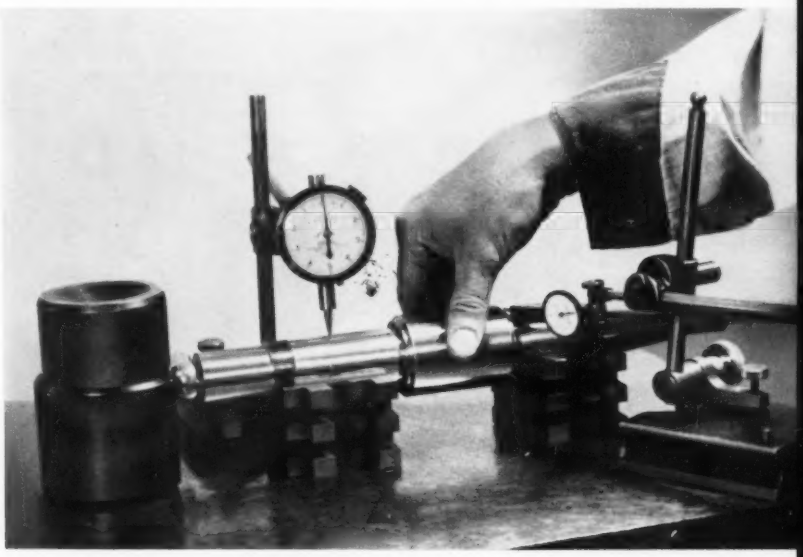


Fig. 2. Shaft is placed on V-blocks and rotated slowly. Dial indicator at left shows bearing seat runout and indicator at right is set to determine squareness of spindle shoulder against which a bearing is seated.

blocks and a micrometer. By rocking the gage in several positions in the housing bore, any out-of-roundness and deviation of diameter is indicated. To discover any existing taper, the gage is moved axially. Housing bores are held within specified limits and checked for finish and freedom from burrs and tool marks.

Spacers, lock-nuts, and slingers are carefully inspected, and all burrs are removed to insure proper seating of the ball bearings. Faces of spacers *A* and *B* (Fig. 1) and slingers *C* and *D* must be flat and parallel within 0.0002 inch and square with their bores. The inner-ring and outer-ring spacers should be equal in length within 0.0002 inch.

Prior to assembly, all parts of the wheel-head (Fig. 3), including housing bores, are cleaned thoroughly with a solvent such as Varsol and then carefully wiped with a clean, lint-free cloth. All dirt must be removed from threads, keyways, grooves, and splines. To prevent corrosion, all parts, including shaft bearing seats and shoulders as well as the housing bores, are wiped with grease, leaving only a thin, protective film.

Excessive Grease May Cause Overheating

For this particular installation two pairs of 35-millimeter bore, light series, angular contact, duplexed super-precision ball bearings are used. In unpackaging, care is taken to prevent the entry of dirt or moisture into the bearings. The light protective oil put in the bearing by the manufacturer need not, as a general rule, be washed or wiped out. Each bearing is carefully packed with about three grams of clean, suitable, ball-bearing grease, using a flat steel scale for inserting the grease into the bearing and around the balls. Grease voids within the bearing are eliminated, and even distribution of the grease is accomplished by revolving the bearing slowly in the hands until the torque throughout the bearing becomes noticeably constant.

It is generally recognized that only grease which is immediately adjacent to and in contact with the bearing contributes to its lubrication. In most applications, unless the speed is exceptionally low, a large quantity of grease can be highly objectionable. An excessive amount increases a churning action, which may lead to overheating and possible breakdown of the grease. The tendency to churn is dependent upon the consistency of the grease, bearing design, housing construction, and the quantity of grease used.

For successful lubrication at high rotational speeds, ball-bearing grease should have good mechanical and chemical stability with low torque characteristics. Two different types of grease, one soft and the other heavier, have proved to be suitable lubricants for spindle bearings. Both greases show a very slight change in consistency after operation of a bearing. As the soft grease has a tendency to churn, particular attention should be given to the amount placed in the bearing. Because the heavier grease is a

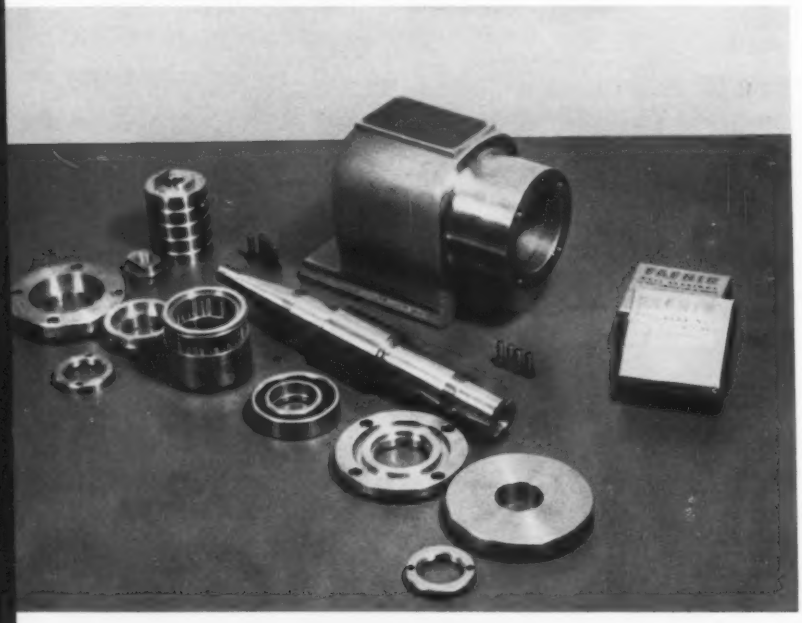


Fig. 3. After inspection, wheel-head parts are thoroughly cleaned in a solvent, wiped dry and given a thin protective film of grease. Here all parts, including new bearings, are gathered prior to re-assembly operations.

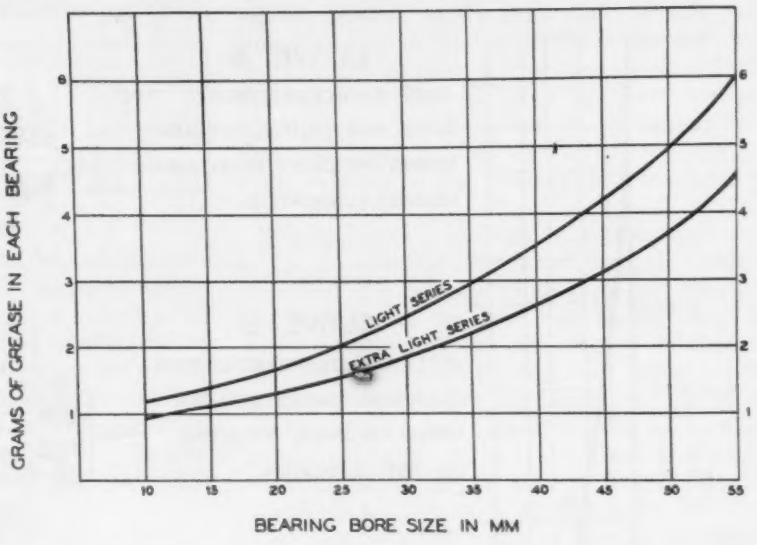


Fig. 4. Graph for determining the approximate amount of grease to be used in super-precision, spindle type ball bearings for bore sizes between 10 and 55 millimeters. Curves for both the light and extra-light series are given.

channelling type which has little of this tendency, the amount used is not as critical.

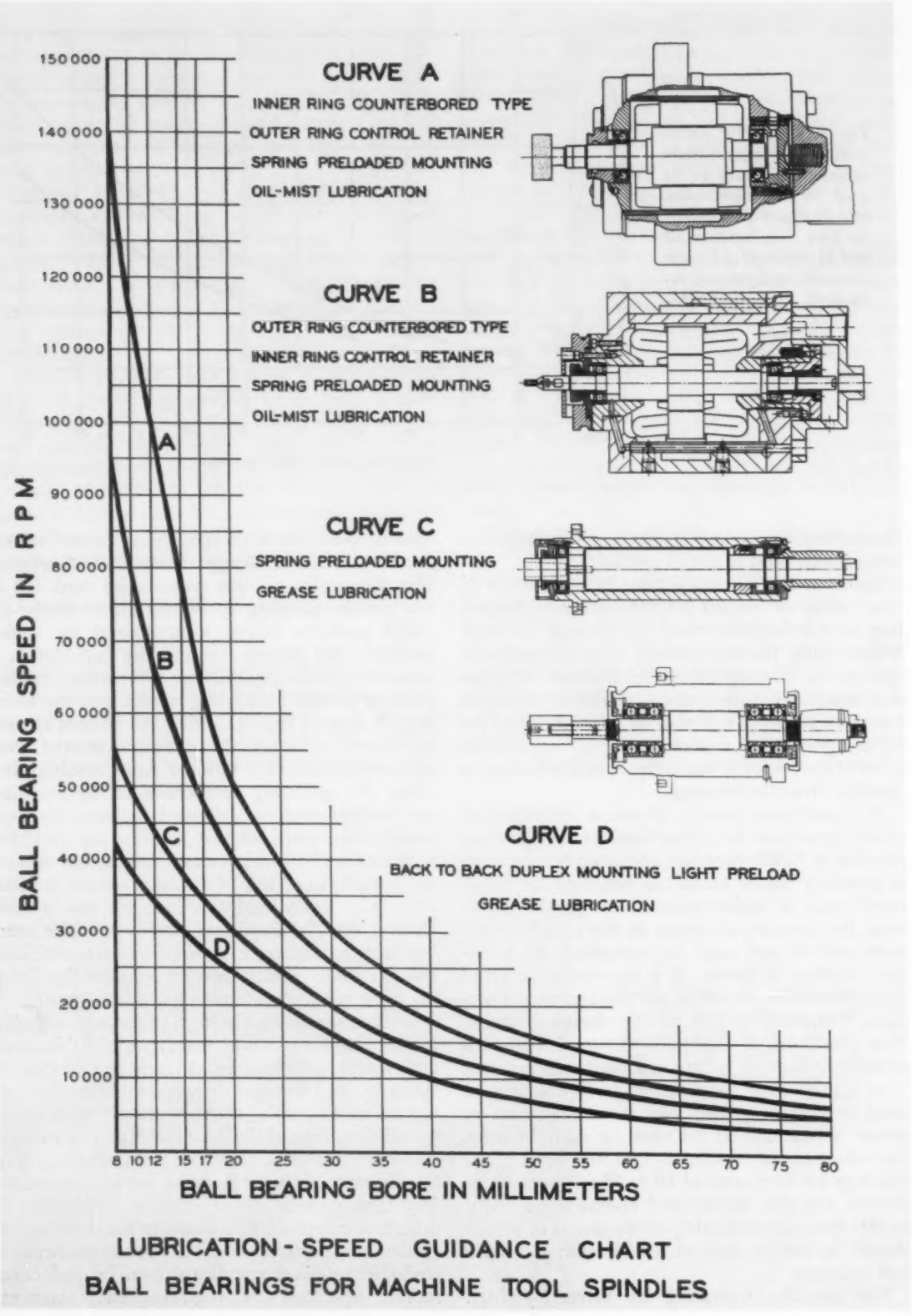
Below a DN (bearing bore in millimeters × rpm) value of around 300,000, either a channelling or a light-consistency grease may be used. When using the channelling type at moderate speeds, the bearing can be packed full of grease and operate without any appreciable temperature rise. Bearings can also be packed full of the lighter grease but a greater rise in temperature would be noticeable until the excess lubricant is expelled from the bearing.

At continuous speeds above a 300,000 DN value, equivalent to a 30-millimeter bore bearing rotating at 10,000 rpm, the operating temperature is generally lower when the bearings are lubricated with a higher-consistency grease. However, the quantity of grease in this case becomes more critical and must be controlled. An excessive amount of grease in a bearing rotating at high speeds may result in greatly increased operating temperatures due to the churning action. This condition, if uncontrolled, could lead to a premature bearing failure in a matter of minutes.

As a guide, the chart shown in Fig. 4 may be used to determine the approximate amount of grease which should be used in each bearing. The chart covers the extra-light and light series bearings for bore sizes of 10 to 55 millimeters inclusive. For this wheel-head operating at about 13,500 rpm, approximately three grams of grease should be used in each of the 35-millimeter bore ball bearings.

For spindles operating at extremely high speeds, such as high-frequency motor wheelheads, the ball bearings demand ideal lubrication. Generally, oil-mist systems are used. Oil of the proper viscosity is atomized into finely divided particles mixed with filtered air under pressure and passed through the bearings in a constant stream. In addition, this method of lubrication provides a cooling medium to the bearings. It is most important that the oil-mist system be turned on before the spindle is started. Premature ball-bearing failures have resulted because the operating instructions of the machine tool builder were not followed. To preclude such possibilities, most oil-mist systems are provided with interlocks which make it impossible to start the spindle until the lubricating system is functioning properly and the bearings are wetted thoroughly. The importance of wetting the bearings before starting cannot be overstressed, and has particular significance for spindles that have not been used for extended periods of time.

Curves shown in Fig. 5 may serve as a guide to the determination of the types of lubrication and mounting to be used in machine tool spindle bearings, and the speeds permissible for operating different sizes of these bearings. High-speed spindle bearings of the light series and extra-light series are included, and bore sizes are from 8 to 80 millimeters. Curve *A* and *B* are for exceptionally high speeds where oil-mist lubrication is definitely required. Ball bearings for these applications are spring pre-loaded. Such mountings include wheel-head spindles driven by induction motors operated on high-frequency current.



LUBRICATION - SPEED GUIDANCE CHART
BALL BEARINGS FOR MACHINE TOOL SPINDLES

Table 2. Range of Mounting Fits Obtained Between Properly Sized Bearings and Housings

Outside Diameter of 35-mm Bearings, Inches	Spindle Housing Bore, Inches	Clearance of Mounting Fits, Inches
Maximum, 2.8346	Minimum, 2.8345	0.0001 interference
Minimum, 2.8344	Maximum, 2.8349	0.0005 loose

Curve *C* is for grease-lubricated, spring preloaded ball bearings, generally mounted singly. In these applications, the grease is sealed in for life, as in belt-driven high-speed spindles for internal precision grinding. Curve *D* is for grease-lubricated, universal duplex mountings with ball bearings having a light built-in pre-load. These bearings are generally mounted in pairs, back-to-back, with or without inner- and outer-ring spacers.

Bearings Are Selectively Assembled in Spindle Mounting

Proper shaft and housing mounting fits must be established and maintained in the application of ball bearings. Generally, for machine tool spindles, the ball bearing should have a line-to-line fit with the shaft bearing seat and a sliding push fit in the housing bore. Before the actual assembly operations begin, the ball bearings may be used for trial purposes to insure the desired mounting fits at final assembly. Damage to ball bearings is avoided by taking care to mount bearings without cocking and to apply a firm hand pressure to the inner-ring face when placing the bearing on the shaft. Only thumb pressure is applied to the face of the outer ring when the bearing is pushed into the housing. Each bearing should be earmarked for its eventual position in the spindle assembly, making certain that the floating or spring-loaded bearings are slightly looser in the housing than the front or fixed bearings.

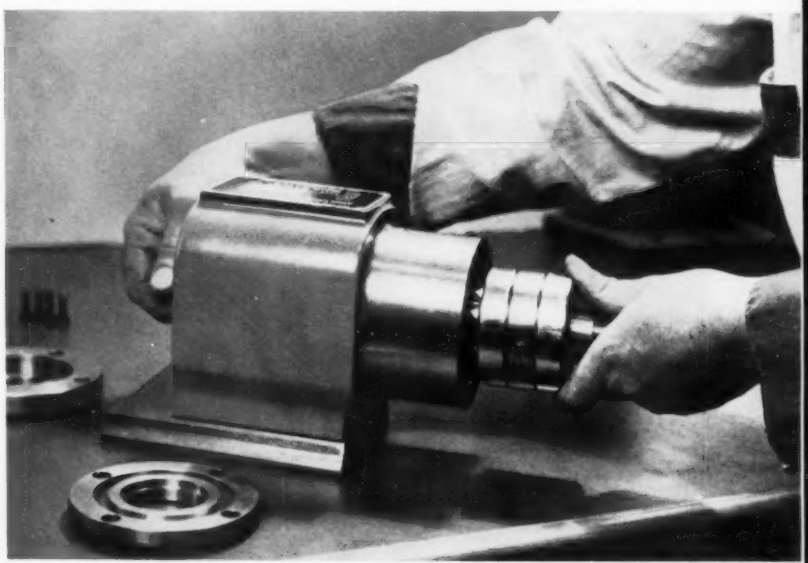
For high-speed applications and in mountings where an adjacent heat input along the shaft is prevalent, it is extremely important that the floating bearings at the drive end be permitted to move longitudinally to compensate for thermal changes. The bearings, therefore, must not be restricted by tight housing bores or by radial expansion of the bearing itself due to a temperature differential between the housing and bearing.

At the wheel end or nose of the spindle, the minimum housing bore dimension for the fixed super-precision ball bearings may be established as 0.0001 inch less than the maximum outside diameter of the bearing. If the bearing outside diameter tolerance is 0.0002 inch, the maximum housing bore dimension is established at 0.0003 inch larger than the minimum housing bore. From Table 2 it can be seen that the average mounted resultant fit is 0.0002 inch loose, and if possible this clearance should be obtained, since it produces the ideal fit of the bearing in the housing bore.

At the drive end of the spindle where the floating bearing is located, it is highly desirable to strive for an average fit of about 0.0001 inch looser than for the wheel-end or nose ball bear-

Fig. 5. (Left) This chart is useful as a guide in choosing a type of mounting, method of lubrication, and permissible speeds for ball bearings on machine tool spindles.

Fig. 6. (Right) Wheel-end bearings and their spacers are first to be mounted on the spindle. Here this sub-assembly is shown being inserted in the housing. The shaft and spindle are assembled with the high points of their eccentricities diametrically opposed.



ings. For the drive end, therefore, this ideal housing fit is 0.0003 inch loose. In operation, the bearing is itself a heat source and the housing functions as a heat sink and radiator. The equilibrium housing temperature is at some level between room temperature and the bearing. Obviously, the bearing will expand at a higher rate than the housing bore. For example: if we assume that the temperature gradient between the bearing and the housing is 10 degrees F., the bearing will expand in diameter approximately 0.0002 inch more than the housing.

In the case of super-precision, pre-loaded pairs of ball bearings for high-speed wheelheads, the ideal shaft fit is a line-to-line fit to one with a looseness of 0.0001 inch. This mounted fit is attained if the bearing is assembled on the shaft under a firm thumb pressure applied on the face of the inner ring. Likewise, a good fit is indicated when the bearing can be assembled by applying gentle tapping blows on the face of a suitable mounting sleeve held against the bearing inner-ring face. For these wheel-head bearings it is generally recommended that the shaft-seat diameter be about the same as the bearing bore. The ideal mounting fit may be obtained by cross-matching the shafts and bearings. The bearing bore is matched with the shaft seat that will result in a mounted fit of 0.0001 inch loose to one of line-to-line. Where single super-precision ball bearings are employed in high-speed wheel-heads, and pre-loading is accomplished by the application of spring pressure, it is good practice to use this shaft-fitting procedure.

Bearing and Shaft Assembled with Eccentricities Opposed

With the burnished spots—denoting the high points of eccentricity—on the faces of the inner and outer rings of the bearings positioned in line, the front pair of ball bearings *E* and *F* (Fig. 1), with their outer-ring thrust faces toward the drive end of the shaft, are mounted in tandem on the shaft *G*. Inner-ring spacer *A* and outer-ring spacer *B* are placed between them. The mounting is done in such a way that the location of the high points of eccentricity of the shaft seat and of the bearing inner rings are diametrically opposed. This sub-assembly is placed in the housing *H*, and shown in Fig. 6.

The ball bearings are then properly seated against the shaft seat shoulder by placing front slinger *C* against the bearing inner-ring face, and lock-nut *J*, having a right-hand thread, is tightened with a spanner wrench. With the outer-ring face of the inboard bearing seated against the internal housing shoulder, lock-nut *J* and front slinger *C* are removed. Next, outer-ring cap *K* and gasket *L* are assembled and secured in place, this cap being locked evenly, parallel, and firmly against the outer-ring face of the outside bearing.

Fig. 7. After installing the thrust collar and spring pre-loading assembly, the drive-end bearings are mounted. Gentle mallet blows on a mounting sleeve, held against the inner ring, seat the bearing.

Front slinger *C* and lock-nut *J* are then replaced, temporarily securing the bearings with a spanner wrench.

After the shaft is in the housing and assembled with the front pair of bearings, thrust collar *M* is mounted on the shaft from the drive end, as illustrated in Fig. 5. This collar is placed with its wide face outward in order to support the preload springs. The springs, in turn, are inserted in a cage unit *N*, which is then mounted in position on the shaft. Spring washer *O* with its grease-packed cavity outward, is placed against the springs.

With the burnished spots in line, ball bearings *P* and *Q* are similarly assembled in tandem but with the thrust faces of the outer rings inward and toward the wheel end of the shaft. Again, the bearings are mounted in such a way that the high points of eccentricity of the shaft seat and of the bearing inner rings are diametrically opposed. Assembly of these bearings is shown in Fig. 7.

After closure cap *R* is securely fastened to the housing, rear slinger *D* is placed in position against the inner-ring face of the ball bearing, and lock-nut *S*, having a left-hand thread, is screwed on the shaft with a spanner wrench. This lock-nut is set by striking the wrench handle with two sharp raps of a light hammer. The procedure is repeated from the opposite side by relocating the spanner wrench on the lock-nut 180 degrees from the first position. The clearance between the closure cap *R* and the rear slinger *D* is checked with a feeler to make sure that no interference exists between the two parts.

Front lock-nut *J* is loosened counterclockwise about four turns and indicator readings taken at the wheel end of the shaft, Fig. 8. If these readings correspond to the nose runout or eccentricity previously obtained when the shaft was inspected on parallel V-blocks before assembly, no inaccuracies have been introduced through installation of the bearing. Following this check, the front lock-nut *J* is screwed on the shaft until the face of the front slinger *C* comes to bear on the inner-ring face of the ball bearing. This lock-nut is set with a spanner wrench to tighten the bearing inner rings together and against the shaft shoulder, Fig. 9. Tightening is done evenly and securely by striking the wrench handle two sharp blows with a light hammer and repeating this operation on the other side of the lock-nut, 180 degrees from the first position. Approximately the same force should be used in tightening the lock-nut every time it is tightened. This is important, especially during the trial and error scraping process.

Once these bearings are locked by the lock-nut, they are a pre-loaded pair in a fixed position, and the spindle is checked for possible runout. Should runout now exist in the assembly, it can be attributed directly to the relation between the threads and locking face of the lock-nut. If the shaft shows a runout of 0.0001 inch or more, it can be assumed that the trouble lies in the lock-

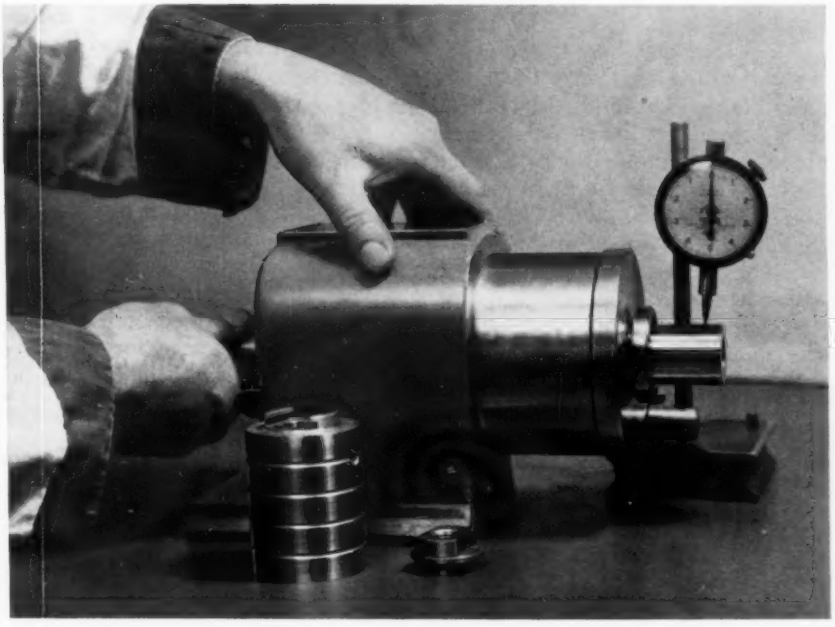


Fig. 8. To check if any inaccuracies have been introduced by the assembly procedure, wheel-end lock-nut is loosened and indicator readings are taken. These should correspond to those obtained before assembly.

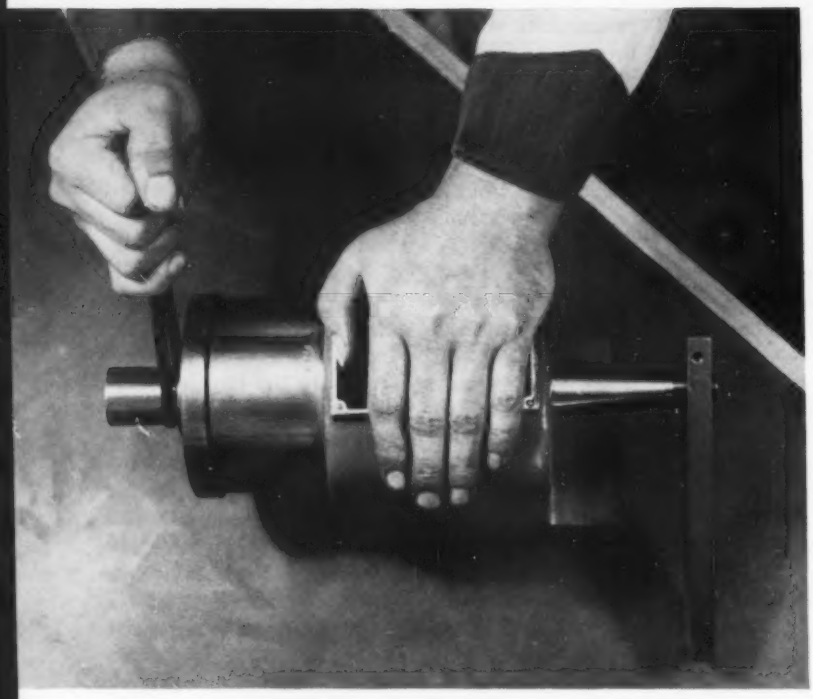


Fig. 9. Spanner wrench is used to tighten the front lock-nut and the bearing inner rings into their operating position. Two sharp hammer blows against wrench handle complete the operation.

nut contact with the outward face of the front slinger. This runout can be eliminated by scraping or lapping the high surface of the locking face of the lock-nut to make it parallel to the front-slinger face.

Face of Lock-Nut Scraped to Eliminate Runout

To determine where to scrape, first check with an indicator over the front end of the shaft at point *X*, Fig. 1, until the highest reading is noted. This shows that the tip of the indicator point is directly over the vertical diameter of the shaft. Stopping at the highest reading on the indicator, the shaft is slowly rotated from the opposite end of the spindle which, in this case, would be the drive or rear end. Stop at the lowest reading on the indicator dial and with a red pencil or metal-marking pencil scribe a line longitudinally along the shaft and on the outside diameter of the lock-nut *J* directly in line with the low reading. The lock-nut is removed from the assembly and the line transferred to its front face. This procedure locates the area to be scraped or lapped.

Scraping, Fig. 10, may be done with a scraping tool on the high surface and on an area extending outward from both sides of the high surface reading. The distance to be scraped on each side of the highest point should be nearly a quadrant. Care should be taken to scrape evenly and uniformly. The depth of scraping (which will always be slight) can be judged only by the amount of runout shown on the indicator dial.

When the estimated amount of metal has been removed by scraping, the lock-nut is washed and blown clean. It is then placed against the face of the front slinger and tightened. New readings are taken, and if the runout persists, the lock-nut is removed and scraped in the same manner. If scraping on the same surface area is necessary, it is obvious that not enough metal was removed the first time. If the high surface is diagonally opposite, too much metal was removed. Scraping is continued until the face shows a very close reading on the indicator. To determine and correct any inaccuracies that might exist at the drive end of the spindle, indicator readings are taken at point *Y*, Fig. 1. After lock-nut *S* is loosened clockwise and removed, the same basic procedures used for the wheel end of the spindle are followed. The wheel-head assembly is then ready for the run-in test and final inspection.

Operating Temperature, Vibration, and Roughness Checked

Before starting the test run for final inspection, the spindle is started and stopped a few times to make sure the wheel-head and the testing equip-

ment are in good working order. The spindle is then brought up to operational speed, which should not exceed the maximum speed indicated on the nameplate.

Temperature readings are taken as close to the bearings as possible, every five minutes at first, for each bearing on the housing. If the wheel-head heats up rapidly, it is stopped, allowed to cool to room temperature, and then re-started. Readings are then taken about every fifteen minutes until the temperature levels off. The wheel-head should not be permitted to run hotter than 50 degrees F. above room temperature or to run so that the heat becomes unbearable to the hand. Generally, temperature readings of more than 120 degrees F. are not encountered. Three to four hours should be a reasonable time for running-in the wheel-head and checking for temperatures, unusual sounds, vibration, and roughness. In the heading illustration, an inspector is seen listening to the front bearings of a wheel-head with a stethoscope.

Following the successful completion of this test, the precision-built wheel-head is ready for use in the manufacturing area. There, if not abused, it should produce consistently accurate work for a long period of time. Being extremely sturdy, the wheel-head is capable of taking normal punishment. However, some degree of caution should be exercised to prevent damage. Carelessness, such as bumping the grinding wheel forcibly against the work or work-holder, must be avoided. With reasonable care and thoughtfulness on the part of the user, the wheel-head will give many hours of trouble-free service.

Pre-loading Decreases Work Load Deflections

The rate of deflection of ball bearings decreases as the load is increased. This is the basic reason for the pre-loading ball bearings. Duplex bearings are pre-loaded with a predetermined thrust so that when the work load is applied, the deflections produced will be markedly decreased.

Upon clamping duplex ball bearings together in a spindle housing under spring pressure, the internal parts of the bearings are subjected to compression and the balls are forced into contact with their respective raceways, thus taking up the initial internal clearances. This condition is similar to that of a bearing in operation under a thrust load and the bearing is therefore said to be "pre-loaded." Axial pre-loading increases the rigidity of ball bearings to reduce both the axial and radial shaft deflections under external loads.

To meet varying conditions of speed, mounting, and rigidity consistent with low operating temperatures, ball bearings are designed and produced for the machine tool industry for use with varying amounts of pre-load from zero to heavy. Each super-precision ball bearing has its established light, medium, and heavy pre-loads, based on the internal characteristics of that size. Other pre-loads to meet specific operating conditions are considered special. The bearings used are especially produced and identified.

Speed and Pre-loading Determine Operating Temperature

For precision machine tools, and particularly for high-speed grinding spindles, where the principal loading imposed on the ball bearing is the pre-load, low operating temperature is an extremely important and a highly desirable feature. Low operating temperature along the spindle

Fig. 10. If runout is discovered after tightening the lock-nut, the face of the lock-nut in contact with the adjacent slinger is at fault. Here the face of lock-nut is being scraped parallel to that of the slinger to eliminate the runout.

means better dimensional stability of the processed work. Lower temperature at the bearings lessens their demand for lubrication and prevents unbearable temperatures at the external surfaces of their housings. Low operating temperature eliminates the possibility of trouble due to thermal effects on mounting fits and pre-loading.

The heat developed at the ball bearings under load is a function of the operating speed and the pre-loading of the bearing. Pre-loading is necessary for axial and radial rigidity requirements. Unfortunately, if speeds are increased, the pre-loading may have to be lessened to maintain proper operating temperature at the bearing.

How the pre-loading of the bearing affects the operating temperature is illustrated in Fig. 11. This graph applies to 207-size, angular-contact, duplexed super-precision ball bearings, mounted back-to-back. Curve *A* is a plot of operating temperature at the bearing outside diameter for the speeds indicated, using bearings with a 150-pound built-in pre-load. Curve *B* is for bearings having a 30-pound pre-load. The slope of Curve *A* is much steeper than that of Curve *B*. Using bearings with a 150-pound pre-load, the temperature rise at the bearing outside diameter is 60 degrees F. when operating at 3600 rpm. For the same temperature rise, using bearings with 30 pounds pre-load, an operating speed of 15,300 rpm is indicated. Therefore it is evident that for higher-speed operation the bearing pre-load should be kept to the minimum necessary to assure sufficient bearing rigidity.

In their efforts to attain even smoother and finer surface finishes, many users of high-speed wheel-heads, especially of the belt-driven type, operate their spindles at higher speeds than those for which they were designed. Spindle failure often occurs due to the rise in operating temperature caused by the breakdown of the lubricant, and because the original spring pre-load on the bearings was not reduced to correspond with that recommended for the increased speed. In such cases, the induced heat expands the internal parts of the spindle, thereby tightening the mounting fits and preventing the floating or spring-loaded bearings from moving axially. Thus, additional heat is generated and failure results. Wheel-head users are cautioned to consult the original equipment manufacturer when increased speeds for their spindles are contemplated.

Many factors are therefore involved in the design, fabrication, and use of high-speed spindles. Among them are the selection of the ball bearings, the amount of applied pre-loading, the mounting fits, the accuracy of the parts and the skill with which they are assembled, the operating temperature and speed involved, and lastly, the type of lubricant—grease, oil, or oil-air mist. Adequate lubrication, low operating temperatures, accurate and smooth operation, low friction, and a high degree of axial and radial rigidity are all extremely important qualities for successful machine tool spindle performance. The attainment of these qualities will continue to require the cooperation of the ball bearing manufacturer and the machine tool builder, as well as the machine tool user.

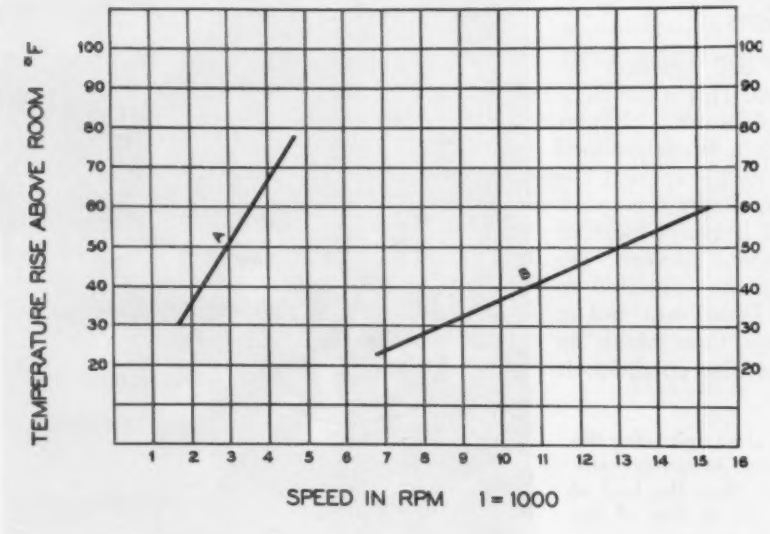
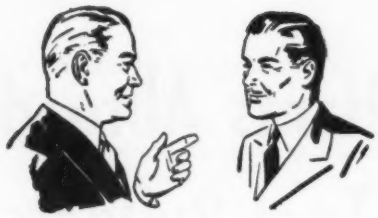


Fig. 11. Graphs of temperature versus rotational speed for angular contact, ball bearings, mounted back-to-back under two different pre-loads. Curve (A) is for a 150-pound pre-load and Curve (B) for 30 pounds.



Talking With Sales Managers

By BERNARD LESTER
Management Consulting Engineer

Examine the Efficiency of Industrial Advertising

DURING a business slump it is normal to strive for ways to save. It is equally important, however, to discover new ways to increase business.

Industrial advertising is far too dynamic in forming customer opinions and influencing decisions to be left to automatic control. Customers' expectations, moods, and interests change rapidly so that what is said and to whom the message goes must also change. Under present business conditions it is not enough to rest on your 1958 plans made last year.

Current studies of the industrial advertising practices of medium-sized equipment builders show there is ample opportunity for improvement. One recent study made by the Industrial Advertisers Research Institute points out that the work of the advertising department is too narrow and insufficiently related to other departments. Though it prepares and places material, this department doesn't define advertising objectives or develop plans cooperatively. In many instances it lacks creativeness and initiative in its "feedback" to the company's over-all sales policies and plans.

To be specific, one company makes precision units sold to a variety of original equipment manufacturers whose plants are widely scattered. This spring the sales manager, in his search for efficiency, got encouraging results from digging into industrial advertising. He worked constructively with the manager of this activity and the outside agency.

A start was made by studying objectives. These had been loosely defined by the words "helping to sell." An orderly re-evaluation of market conditions pointed up changes and steps to take and the order of their importance. For instance:

—some classes and types of machinery the customers were building had actually increased in demand rather than declined.
—since a recession always promotes redesign, the design engineer had now become a chief target for attention.
—with inventories bulging, small-lot ordering had a new appeal.
—since original equipment manufacturer's repair business had boomed, demands were appearing at new locations for replacement parts.

Such market changes as these defined current objectives and suggested methods of action.

Consultation with the advertising manager and agency revealed that slight consideration had been given the rapidly expanding number of advertisements by component parts suppliers. With this growth, advertising messages on parts alone had tended to become stilted. Most ads told how good the part was, rather than how it improved the design, construction, and salability of the completed machine. Emphasizing product rather than use is still a common tendency that shows how we lack imagination.

Beyond a study of objectives and what to do, this sales manager tried to find those causes that lead to inefficiency. The advertising department had been an independent, closely-knit, hard-working group that was tightly controlled. The manager kept his finger on everything, but he took little part in cross-table planning. Advertising and sales promotion, to succeed, must be constantly related to other activities, especially with product development, market research, and selling. It not only serves other departments but needs their interest and help. Coordination was badly needed.

The agency had been regarded an outsider. It was left alone in preparing copy and placing space. It was not given full opportunity to be informed; on the other hand, no demands were made on it for services beyond those named. The agency had not been put to work to share, for instance, in those studies concerned with customer acceptance of equipment and service.

We emphasize this instance of a joint investigation by the sales manager, advertising manager, and agency because it is proving very helpful in building up much needed business. No heads have been cut off, though advertising personnel has been trimmed by transfers to other work. Best of all, the work of each employe has been inspired and re-directed.

Find out how your advertising department is run, but don't try to run it.

Reciprocal Trade and Plants Abroad Discussed by Machine Tool Builders

UNLESS the present tariff situation is somehow corrected, the inevitable result will be the upbuilding of machine tool capacity in Europe and the decline of that industry in the United States, according to statements made by Alfred V. Bodine, president of the National Machine Tool Builders' Association, and president and treasurer of the Bodine Corporation, Bridgeport, Conn., in his speech before the 56th spring meeting of the Association. This meeting was held at the Edgewater Beach Hotel, Chicago, Ill., April 23 through 25, inclusive.

Mr. Bodine pointed out that not so many years ago, imports accounted for only a small fraction of domestic sales. It is estimated that today imports of general-purpose cutting type machine tools are equivalent to about 30 per cent of the domestic net new orders being received. Our machine tool exports formerly accounted for 30 per cent of American production. Currently they are down to about 10 per cent.

Mr. Bodine mentioned that the main reason for this change in the export situation is the price differential, which is accounted for primarily by the difference in wage rates. The average hourly rate of pay for skilled machine tool mechanics in the United States is about $2.65, whereas in Europe it ranges between 40 cents and $1.25.

The United States tariff for machine tools is 15 per cent for most machines and 18 to 20 per cent for a few types. On the other hand, the American machine tool builder not only faces the handicap of a big price differential when he exports, but he also faces tariff difficulties and nationalistic restrictions. The foreign countries which represent our major export markets have imposed tariffs, special fees, and taxes that in some cases add up to 55 per cent. Several countries have licensing systems which amount to an embargo on some types of American machines.

What is bound to happen, according to Mr. Bodine, is that American machine tool builders will move production capacity abroad. He pointed out that in every previous national defense emergency the machine tool capacity of the United States was stretched to the utmost, and he raised the question as to how this country can be ready to defend itself if the machine tool building capacity is reduced. Mr. Bodine suggested three remedial steps which the United States Government could take:

1. Establish tariffs or quotas on machine tool imports which will insure the national defense production capacity of the United States.
2. Persuade foreign countries to relax licensing and importation restrictions, and agree upon a tariff arrangement which is in fact reciprocal.
3. Interpret the "Buy-American" Act so that it will not be mandatory for the Defense Department to buy a foreign-built machine tool if its price is as much as 6 per cent below a quotation by an American builder.

As to the current outlook for domestic sales, Mr. Bodine said: "I believe that sheer economic necessity, as the year advances, is going to spur machine tool replacement. Under the pressure of price and quality competition, companies will have to modernize or go out of business. I am certain that by convincing customers of the need for replacement and quality improvement we can develop a sales upturn as the year progresses."

Several papers were presented at the meeting which dealt with foreign industries and with the reasons why a number of American concerns have already established plants abroad. Ralph J. Kraut, first vice-president of the Association and president of the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., referred to the fact that in only ten years Germany had developed one of the world's most modern machine tool industries out of the "rubble" of 1946-1947. Last year the output of machine tools in Western Germany reached over 1,800,000,000 deutsche mark—equal to over $700,000,000. Our output amounted to $1,088,450,000, so here is a contrast of a country with 30 per cent of our population having 70 per cent as large a machine tool business. Mr. Kraut also pointed out that in 1957 the estimated output of the British machine tool industry was equal to $500,000,000 of our output. Therefore, Germany and Great Britain outproduce the United States as far as machine tools are concerned despite the fact that their combined pop-

ulation amounts to approximately 60 per cent of the American populace.

In his paper "British Cutting Tool Industry and Why Lapointe Located Abroad," John J. Prindiville, Jr., president, treasurer, and general manager of the Lapointe Machine Tool Co., Hudson, Mass., mentioned that his father in 1919 had bought a plant in England and commenced the making of broaches and broaching equipment. His was the first American machine tool firm to be incorporated in that country. In 1947 it was decided that machines also would be built in the British factory. Today, the concern has a new plant located about ten miles outside of London. Mr. Prindiville dealt at considerable length with British production of machine tools, their export markets, and their special problems.

Robert G. Friedman, president and general manager of the National Machinery Co., Tiffin, Ohio, stated that his concern had recently consummated an agreement to consolidate with a company in Western Germany so that his concern could fully participate in selling to foreign markets. Before doing so, such barriers to foreign sales were considered as duty, freight insurance, difficulty of servicing, and provision of adequate delivery of spare parts, and these barriers were not thought entirely insurmountable. Even the occasional devaluation of foreign currencies which raised prices abroad would not have removed their hopes of being able to compete in foreign markets. This was also true of the difference between labor rates abroad and at home. However, whereas the early post-war years held out the hope that the dollar shortage, with resulting restrictions against exporting to foreign countries, might be temporary, each passing year made it look more permanent.

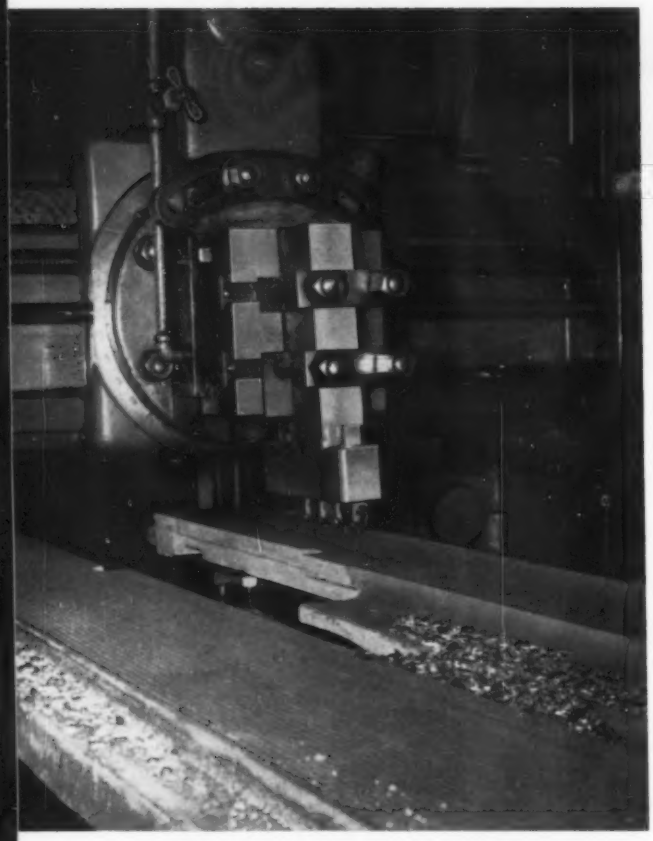
It therefore became apparent that unless the National Machinery Co. was willing to forego a large part of the foreign markets over the future, its products had to be built outside of the dollar area. The decision as to where this should be done was narrowed down with the development of the Continental European common market. The area included in the common market seemed to represent the largest single potential foreign market, so it was decided that any full-fledged program of manufacturing abroad should be carried on within that area.

Robert Potter, president of the E. W. Bliss Co., Canton, Ohio, stated that the principal advantage of having a plant in England is that it represents the most effective way under current conditions of participating in the profits of trade within the sterling area. Mr. Potter said that this applied particularly to such products as metal-forming machinery, in that such machines are all subject to direct competition and particularly every machine that the Bliss Co. has built in recent years can be supplied in approximately similar form by British manufacturers. The prospect of importing this class of machines into the United Kingdom, except in the form of prototypes, is negligible.

"In other words," said Mr. Potter, "if anyone wants to participate in a larger world market for metal-forming machinery, it is necessary to have manufactuing facilities politically and economically able to serve the area. To me this is the fundamental advantage in having a foreign plant. The second direct advantage to the parent company is that foreign plants are a form of diversification. A subsidiary company operating outside of the United States will not necessarily be subject to the full extent of changes in the American economic situation. We see this today. Here at home the machine tool market has slumped temporarily—perhaps 50 per cent—and the sales of presses are off even more, but we find that our English company is still in a fairly healthy situation backlog-wise, and although new orders have fallen off, they are considerably better than they have been in the United States."

In his report on the activities of the Metalworking Equipment Division of B. D. S. A., Arvid O. Lundell, adviser to the director, and president of the Colonial Broach & Machine Co., Detroit, Mich., feels that the procurement of foreign-made machine tools by the Army, Navy, and Air Force is detrimental to the Nation's mobilization base. Also, the Division is continually recommending a strong and active program for the modernization of government-owned inventory of machine tools. Mr. Lundell stated that the Division has spearheaded a program for channelling surplus machine tools into junior high schools, high schools, technical schools, colleges, and universities.

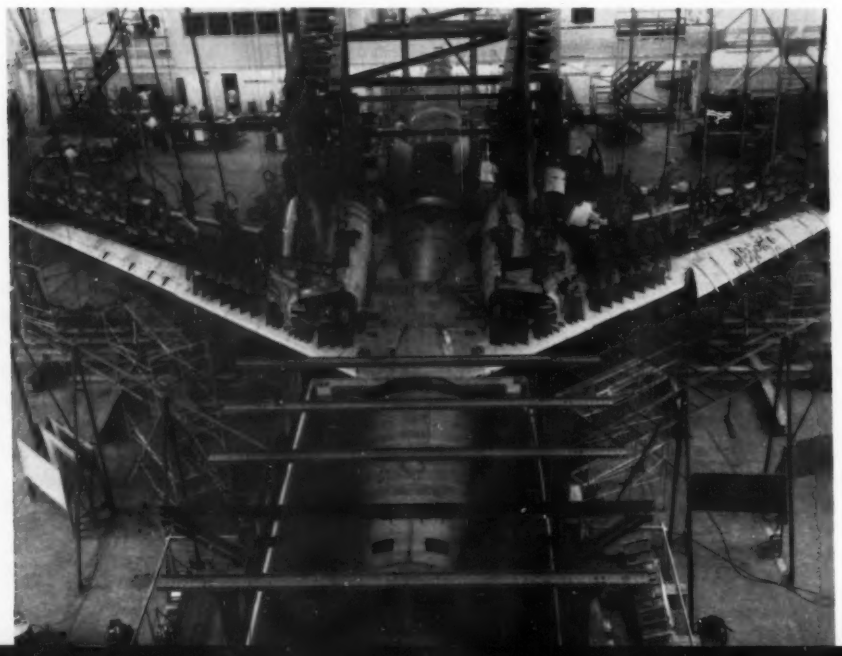
One of the outstanding sessions of the meeting was devoted to a panel discussion of world trade and machine tools. Henry D. Sharpe, Jr., president of Brown & Sharpe Mfg. Co., Providence, R. I., was the moderator of the panel. Other members were Noble B. Clark, sales manager, Machine Tool Division, the Warner & Swasey Co., Cleveland, Ohio; James K. Fulks, executive vice-president, Ex-Cell-O Corporation, Detroit, Mich.; George H. Johnson, president, Gisholt Machine Co., Madison, Wis.; and J. Herbert Myers, director of overseas operations, the Cincinnati Shaper Co., Cincinnati, Ohio. An inspiring talk entitled "The Collapse of Time" was given by J. Louis Powell, Office of the Assistant Secretary of Defense. Mutual security and world trade were the subjects of a speech given at the general luncheon by C. Douglas Dillon, Deputy Under Secretary of State for Economic Affairs.



Camera highlights of some interesting operations performed in various metalworking plants throughout the nation

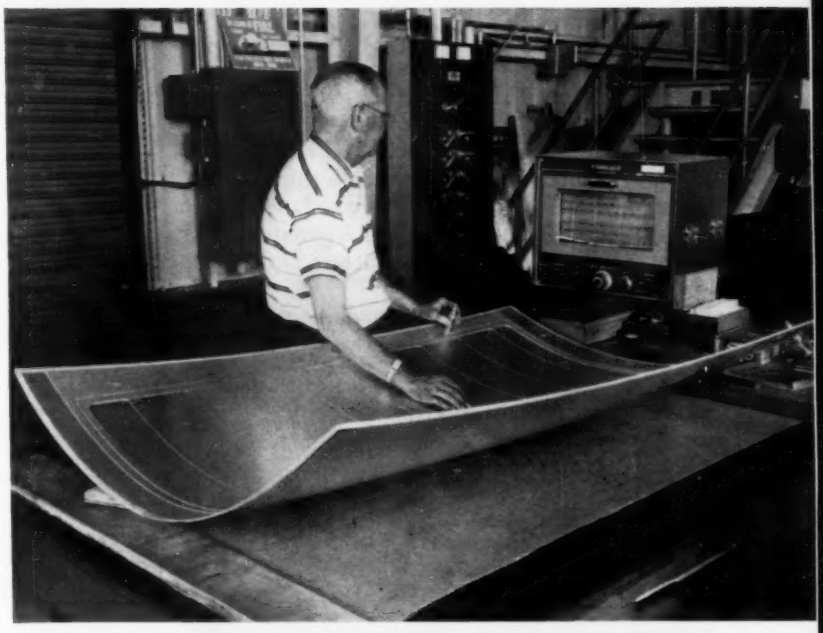
CUTTER GANG—A company-developed multiple tool-holder speeds the rough planing of cast-iron saw table tops, at the G. M. Diehl Machine Works, Wabash, Ind. Four Kendex tools equipped with carbide throw-away inserts, offset from each other by 0.055 inch, take a 1/4-inch deep cut at a feed of 0.200 inch and a speed of 100 feet per minute. Square in shape, inserts have available eight cutting edges each.

PRE-FLIGHT TEST—While its nose is submerged in water for airframe tests of cabin pressurization, the wings of a P6M SeaMaster are subjected to structural forces of 300 to 450 tons or more, at the Martin Co., Baltimore, Md. Hydaulic pressure is applied to the wings through a series of vertical steel straps and a network of whiffletree-like linkages to rubber pads cemented to the wing surfaces.



PRONTO PAINTER—One man in three and a half minutes paints as many small parts as formerly a crew of three did in an hour, with the help of this revolving wire-cage drum, at Boeing Airplane Co. Seattle, Wash. During the operation, an air blast keeps the parts from sticking together. An extremely fast-drying paint is used.

THICKNESS CHECKER—Skins chemically milled at Grumman Aircraft, Bethpage, N. Y., are inspected for thickness ultrasonically in just a few minutes. Scale readings on the equipment, a Vidigage, have increments as fine as 0.0005 to 0.002 inch, and permit ready interpolation to within a half of a division. The inspection was practically impossible to perform by any other method.



SQUIRT WELDER—A bead is laid down around a washer on a railroad revolving car dumper at the Wellman Engineering Co., Cleveland, Ohio. Using Lincoln Electric's new mechanized squirt welder, the submerged-arc technique eliminates beveling, and gives good penetration, making a small bead practical, and reducing amount of weld metal required.

MACHINERY'S PROBLEM CLINIC

Mathematical problems in shop work and tool design submitted by readers of MACHINERY

Edited by HENRY H. RYFFEL

Eccentric Turning with a Three-Jaw Chuck

M. Barash

Short eccentric shafts and eccentric bores are sometimes machined by "offset" holding in a three-jaw self-centering chuck. The offset is produced by placing a pad of suitable thickness between the work-piece and one of the jaws as seen in Fig. 1. The thickness x of the pad is not, as might be assumed at first glance, equal to the amount of eccentricity e.

Fig. 2 shows the geometric relations used in determining x. In Figs. 1 and 2,

O = center of chuck and center of the eccentric portion of the work-piece;
C = center of the work-piece;
e = eccentricity (throw);
x = thickness of pad;
$r = d/2$ = radius of work-piece; and
R = radius of chuck opening.

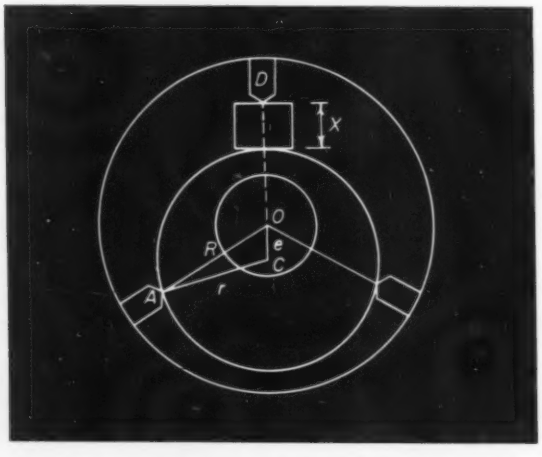


Fig. 1. Work-piece positioned in chuck by pad (x) for eccentric turning operation.

Solution:

1. In Fig. 1,

$$\overline{DO} + \overline{OC} = R + e = r + x \text{ so that}$$
$$x = R + e - r$$

2. Applying the law of cosines to Fig. 2,

$$R^2 = e^2 + r^2 + 2er\cos\alpha$$

3. $\overline{CB} = \overline{OB} - \overline{OC}$, but, since
$\overline{CB} = r\cos\alpha$ and since $\overline{OB} - \overline{OC} = R\cos 60^\circ - e$,

$$r\cos\alpha = R\cos 60^\circ - e$$
$$= \frac{R}{2} - e$$

4. Substituting from (3) in (2) for $r\cos\alpha$,

$$R^2 = e^2 + r^2 + 2e\left(\frac{R}{2} - e\right)$$
$$= e^2 + r^2 + eR - 2e^2$$
$$= r^2 - e^2 + eR$$

5. Since $r = d/2$, (4) becomes

$$R^2 = \left(\frac{d}{2}\right)^2 - e^2 + eR$$

$$R^2 - eR + \left(e^2 - \frac{d^2}{4}\right) = 0$$

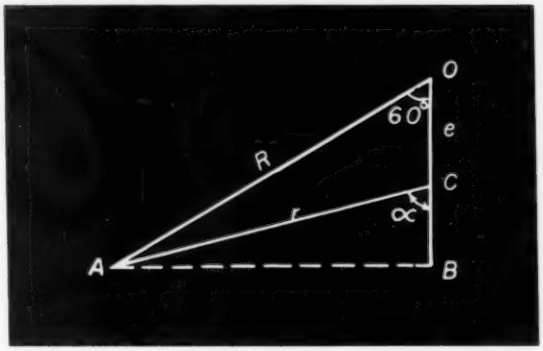
6. Solving (5) for R using the standard quadratic formula,

$$R = \frac{e \pm \sqrt{e^2 - 4\left(e^2 - \frac{d^2}{4}\right)}}{2}$$

$$R = \frac{e \pm \sqrt{d^2 - 3e^2}}{2}$$

In this equation the minus sign preceding the square root may be dropped, since it corresponds

Fig. 2. Geometric relations used in determining thickness of pad (x) shown in Fig. 1.



to a slot cut in the work-piece to produce eccentricity e. Thus,

$$R = \frac{e + \sqrt{d^2 - 3e^2}}{2}$$

7. Combining (1) and (6),

$$x = \frac{e + \sqrt{d^2 - 3e^2}}{2} + e - \frac{d}{2}$$

$$= \frac{3e - d + \sqrt{d^2 - 3e^2}}{2}$$

If the eccentricity is small, that is, the ratio e/d is much smaller than 1, then a simplified approximate formula based on (7) may be obtained as follows:

8. $$\sqrt{d^2 - 3e^2} = d\sqrt{1 - \frac{3e^2}{d^2}}$$

By the binomial expansion,

$$d\sqrt{1 - \frac{3e^2}{d^2}} = d\left[1 - \frac{3e^2}{2d^2} - \frac{9\,e^4}{8\,d^4} - \cdots\right]$$

so that a good approximation when e/d is much less than 1 is obtained by using the first two terms within the brackets:

$$d\sqrt{1 - \frac{3e^2}{d^2}} = d - \frac{3e^2}{2d}$$

9. Substituting (8) in (7),

$$x = \frac{3e - d + \left(d - \frac{3e^2}{2d}\right)}{2}$$

$$= \frac{3e}{2}\left(1 - \frac{e}{2d}\right)$$

Example 1: $d = 2$ inches, $e = 0.2$ inch.

Using Formula (7),

$$x = \frac{3 \times 0.2 - 2 + \sqrt{2^2 - 3(0.2)^2}}{2}$$

$$= 0.2849 \text{ inch}$$

Using Formula (9),

$$x = \frac{3 \times 0.2}{2}\left(1 - \frac{0.2}{2 \times 2}\right)$$

$$= 0.2850 \text{ inch}$$

Example 2: $d = 2$ inches, $e = 0.5$ inch.

Using Formula (7),

$$x = \frac{3 \times 0.5 - 2 + \sqrt{2^2 - 3(0.5)^2}}{2}$$

$$= 0.651 \text{ inch}$$

Using Formula (9),

$$x = \frac{3 \times 0.5}{2}\left(1 - \frac{0.5}{2 \times 2}\right)$$

$$= 0.656 \text{ inch}$$

The results of Example 2 indicate that even with a ratio $e/d = 1/4$, the error resulting from use of the approximate formula in (9) is not any worse than the error of an ordinary chuck.

* * *

American Tooling Practices Could be Modernized

If, as has been said, the progressiveness of a manufacturing industry can be measured by the improved tools it uses, many metalworking industries in the United States have much room for improvement. According to a recent survey conducted by an independent technical research organization for the Wesson Co., Detroit, Mich., obsolescent machine tools and confused carbide specifying, buying, testing, and application practices are severely hampering many companies' attempts to achieve worthwhile cost reductions.

Although not primarily planned to uncover information on how widely carbide tools are used, the survey revealed that industry makes use of carbides on only one-third of its metal-cutting machine tools. Even more surprising is the fact that approximately half of the machine tools employed are not suitable for the application of carbides.

Respondents in the transportation industry—generally considered as being more carbide-conscious than others—indicated they have carbides on only three out of every four machines on which they *could* use such tools. At the other end of the scale, only about 15 per cent of the machine tools used in the fabricated metal-products industry are tooled with carbides although 36 per cent could be so tooled.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts and

Pratt & Whitney Keller Automatic with Special Tilting Head

The development of a Keller automatic tracer-controlled milling machine, with a special milling head that can be tilted 20 degrees above or below the horizontal position, has been announced by the Pratt & Whitney Co., Inc., West Hartford, Conn. This machine is designed especially for the profile-milling of "warped" surfaces of aircraft components which must be accurately machined to conform with the contours of the aircraft's outer surface. The new miller is a modification of the BG-22 Keller used extensively in the automotive and aviation industries for machining large dies, molds, and forged parts.

The first of the new tracer-controlled Keller machines with tilting head has been delivered to North American Aviation, Inc., for installation at its Columbus, Ohio, plant. This machine, weighing over 75 tons, is the first four-axis milling machine built by Pratt & Whitney, the earlier models being two- and three-dimensional types. The new machine is capable of doing all the various types of work performed on a standard Keller in addition to machining warped shapes by utilizing the new tilting motion of the cutting head. A template, mounted parallel to the horizontal motion of the machine so that it presents a rise-and-fall motion to a roll follower, controls the angle of tilt through servo action.

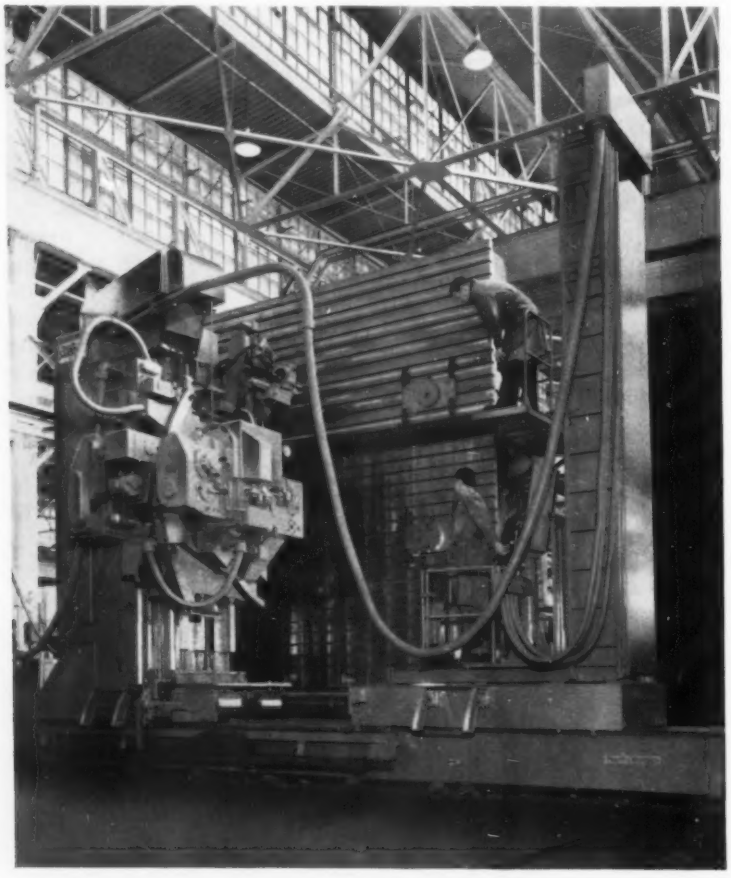


Fig. 1. Keller automatic tracer-controlled milling machine with special tilting head developed by Pratt & Whitney

In actual operation the tilting head is said to have effectively demonstrated its ability to speed up machining work, improve the quality of finish, and reduce the time spent in hand-finishing warped shapes. Thus it provides a much faster, more direct and less costly method of producing these structural members.

A unique feature of the tilting-head machine is the location of the operator's control panel. This unit is contained in an independent electrically powered elevator that allows the operator to view his work from the most advantageous position, regardless of the location of the milling cutter.

The machine has horizontal travel movements of 10, 12, and 14 feet, vertical travel of 48 inches, and transverse travel of 15 inches. The distance from pivot point to spindle nose ranges from 3 1/2 to 11 1/2 inches. The spindle has a vertical adjustment (eccentric) of 4 inches. Minimum distance from table to spindle is 46 1/4 inches. The distance between tracer and cutter is adjustable from 56 to 76 inches. The spindle has a No. 16 B & S taper.

Standard spindle speeds range from 30 to 1800 rpm in 14 steps.

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

Three additional ranges are optional: 15 to 900; 20 to 1200; and 25 to 1500 rpm. Operating spindle speeds from 60 to 3600 are available, but for this extra wide range spindle speeds below 1800 rpm must be used only at reduced horsepower. Horizontal and vertical rapid travel is at the rate of 250 inches per minute. Transverse rapid travel is rated at 140 inches per minute. The horizontal, vertical, and transverse travel rates are all the same, ranging from 0.5 inch to 30 inches per minute. The automatic horizontal and vertical feed per step is from 0.050 inch to 20 inches. Ten motors, ranging in size from the 1/20-hp that drives the automatic lubricating system to the 30-hp spindle driving motor, comprise the power equipment.

Circle Item 101 on postcard, page 179

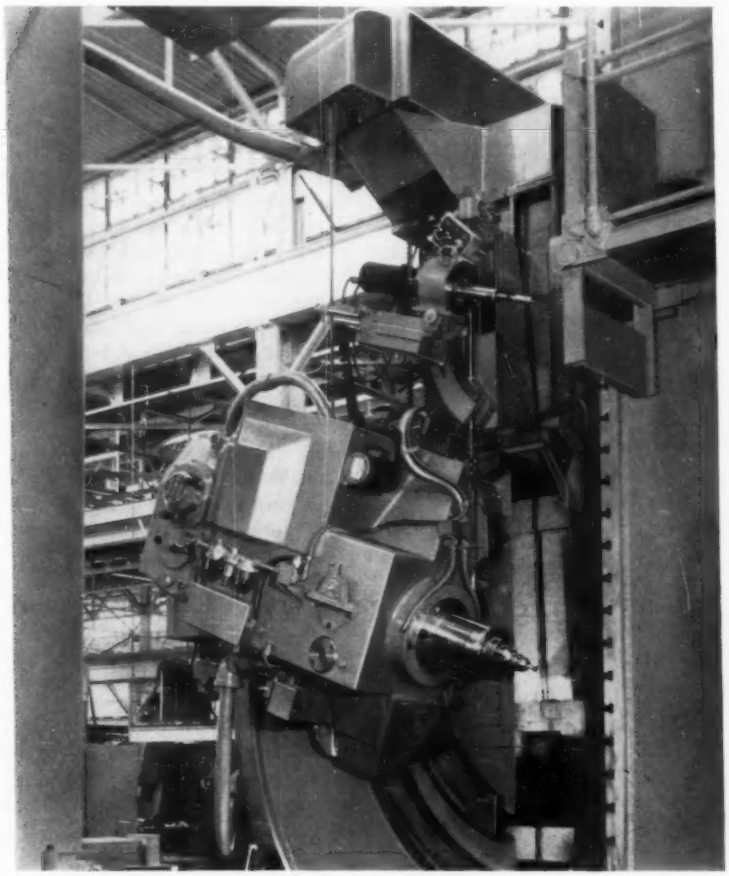
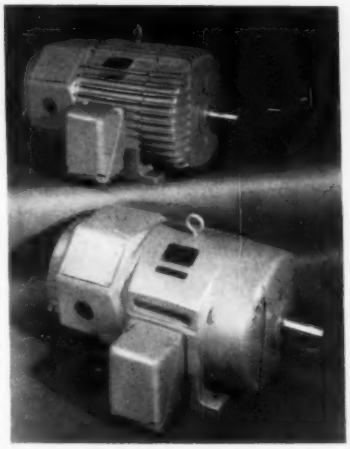


Fig. 2. Close-up of special tilting head of machine shown in Fig. 1

GE Wound Rotor Motors

Two new wound rotor motors featuring a significant size reduction—up to half the size and weight of previous models—have been announced by the General Electric Co., Schenectady, N. Y. Having a minimum breakdown torque of 275 per cent, the motors feature up to 59 per cent size reductions and 49 per cent weight savings. These new Tri-Clad 55 wound rotor motors are available from 5 through 150 hp.



GE wound rotor motors

Type MR motors, intermittent rated for crane and hoist operation, are available with either totally enclosed non-ventilated or drip-proof enclosures. They are best suited to applications requiring varying speeds and high-starting or maximum torque. Type M motors, rated for constant or adjustable speed, are available with open drip-proof enclosures for application on industrial equipment such as pumps, compressors, and fans.

A feature of the type MR motor is the ability to convert from drip-proof to totally enclosed non-ventilated type by simply adding or removing hand-hole covers and changing pulley end-shields. This conversion can be accomplished in ratings ranging from 7 1/4 through 30 hp.

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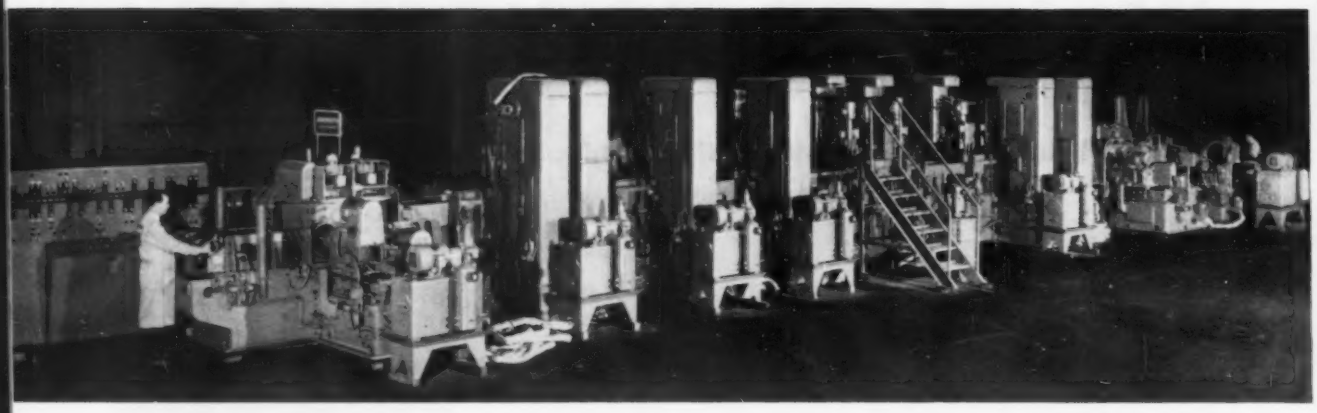


Fig. 1. Thirty-six station Buhr "Economatic" developed to machine aluminum die-cast transmission extensions

Buhr Automated Multiple-Operation Machine for Quantity Production of High-Quality Transmission Parts

An automated multiple-operation machine, 85 feet long, assembled from standard building-block components with a minimum of component engineering time, has been developed by the Buhr Machine Tool Co., Ann Arbor, Mich. This 36-station "Economatic" walking-beam in-line transfer machine will be used by a major automobile manufacturer to turn out high-quality transmission extensions in large quantities. It completely machines 171 aluminum die-castings per hour when operating at 100 per cent efficiency. Operations include boring, facing, drilling, reaming, tapping, chamfering, spin-facing, gaging, and assembling a bushing in the work-piece under regulation of static-control elements.

Each index movement of the walking beam advances the work-pieces 2 feet. The machine has three work-piece positioners, an automatic unloader, automatic air-gaging and washing equipment, bushing orienter, assembly station, unit for spin-facing of one end of the work-piece, and static-control units in the electrical circuits. The typical positioner shown in Fig. 2 immediately precedes the bushing-insertion station. A revolving arm engages a hole in the flange while the part turns in a V-type nest. Correct orientation is maintained because the arm stays in engagement until the transfer bar approaches the part for pick-up. At this time, the arm is retracted and the part is indexed, correctly oriented, to the next station.

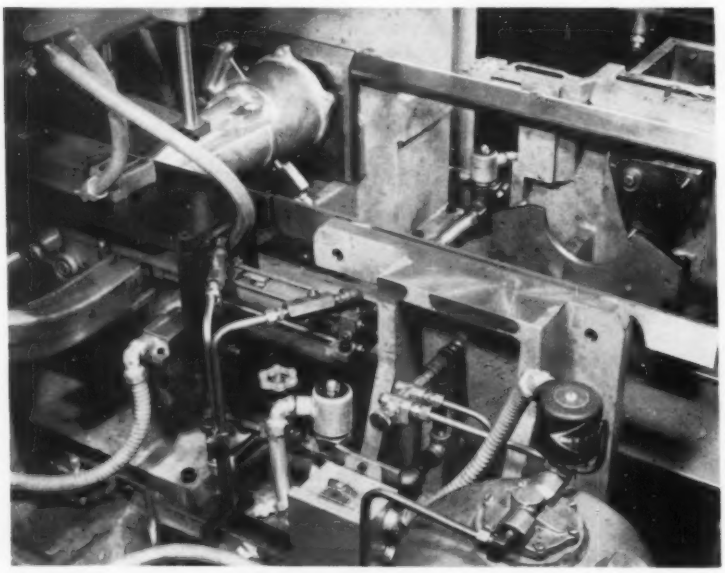


Fig. 2. One of three stations of the machine shown in Fig. 1

At the last station, seen in Fig. 3, the processed part is gripped at the flange end and swung upward and outward away from the cradle on the transfer bar, then deposited, large end down, on a roller conveyor which carries it by gravity to the succeeding machine.

Four blow-out and air-gaging or probing stations were incorporated in the machine to prevent tool breakage and part spoilage. Air gages serve to assure product quality by indicating condition of tools. When parts are "on tolerance," a green lamp is lit. As the part dimension approaches the low limit, a yellow "caution" lamp is lit to indicate tool wear. If parts are outside of the tolerance limits, a red light is flashed and the machine is shut down. The probes are used to detect broken tools, thus preventing smash-ups on subsequent operations. To simplify maintenance, all tools that will require frequent changes have been located in one area of the machine.

Mist-lubrication systems are used in the various drill heads and a velocity trench, running the

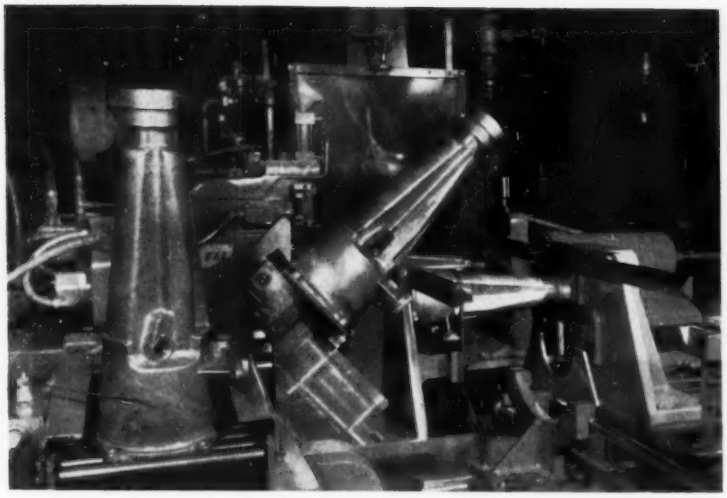


Fig. 3. Thirty-sixth and last station of Buhr multiple-operation machine

length of the machine, is provided to dispose of chips. The coolant system has a capacity of 1000 gallons of soluble oil. Various machine motions are powered by 32 motors. These range from 1/2 to 10 hp for a total of 83 1/2 hp.

Circle Item 103 on postcard, page 179

Numerically Controlled Machine Now Available for Small-Lot Job Shop Operations

The first model of a numerically controlled machine claimed to be suitable in size and price for "job-shop" use by smaller plants was announced recently by the Morey Machinery Co., Inc., New York City, and the Electronic Control Systems Division of Stromberg-Carlson, Los Angeles, Calif., a division of General Dynamics Corporation. Utilizing an adaptation of the "Digimatic" numerical control system described in February 1958 MACHINERY, page 185, a Morey Model A-50 milling machine has demonstrated its capacity for rapidly and automatically turning out contoured parts programmed directly from blueprints.

The Digimatic system of the Morey A-50 machine shown in the accompanying illustration is said to incorporate a number of features such as the rugged high-power magnetic amplifiers, designed to provide maximum reliability. An electronic interpolator or "Director," for example, makes it possible to cut smooth, circular contours or true circles.

The Morey A-50 machine with Digimatic controls is now being made in production quantities for aircraft plants, and will be supported by a number of conveniently located "tape-centers" having adequate tape preparation capacity.

The Digimatic control unit occupies less than 12 square feet of floor space, yet is fully capable of running a 4- by 4-foot bed type machine, including its heavy-duty 30-hp spindle with full three-axis operating range, including line and circle machining. Self-checking features and modular-design packaging principles make the control console simple to use and maintain under tape control. Cutting speeds up to 100 inches per minute are available, with tolerances held to 0.001 inch. The machine is also equipped with micro dials for positioning and push-buttons which enable the operator to use it as a conventional milling machine.

Using economical half-inch magnetic tape operating at a speed of only 7 1/2 inches per second, a full hour of machining can be accommodated on a 2400-foot roll of tape constituting a full tooling record. The 30-hp spindle, with speeds variable from 20 to 3600 rpm, provides an exceptionally wide range of control suitable for machining heat-treated steel as well as the softer metals and alloys, such as aluminum and magnesium. Other design features include anti-friction mounting of all components, roller-bearing saddle and table mounting, recirculating precision ball-nut leadscrews, and anti-backlash gearboxes.

Circle Item 104 on postcard, page 179

Morey Model A-50 milling machine with Digimatic numerical control system

Automatic Parts-Handling Unit

A high-capacity demand-feed storage unit for parts that can roll is being manufactured by the Gear-O-Mation Division, Michigan Tool Co., Detroit, Mich., for use in automated processing lines. This unit consists basically of "zig-zag" gravity part-retaining tracks, fed from integrated parts elevators. The capacity of the unit shown ranges from 1500 parts (2 1/8 inches in diameter by 1 1/8 inches wide) up to 3000 parts (1 3/8 inches in diameter by 1 1/8 inches wide). These units are designed to insure production continuity of a line, particularly during tool changes, by providing a true demand-feeding system.

The parts are fed from a distribution system to an entry point at the lower right end of the unit. From here they enter an elevator that raises them to the top of the cabinet, where they roll into the first section of zig-zag tracks. Each part traverses the full complement of tracks, (five sections), rolling from top to bottom, then is re-elevated for entry into the second section, etc. Parts leave the unit from an exit chute at the upper left end of the cabinet.

The parts elevator is a roller-chain type, using only two chains connected by bars. Drive is from a 1/4-hp motor through a Cone-Drive speed reducer and a V-belt drive. Belt speed is completely variable to suit the application. The motor is mounted at the top of the elevator for easy access.

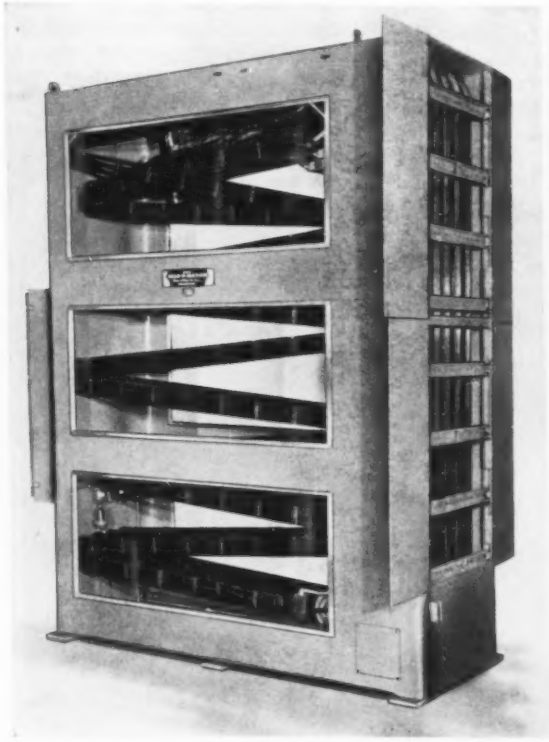
As parts leave the retaining tracks at the upper level of the equipment they are gravity rolled to the exit chute take-off. They can be positioned vertically or horizontally for the following machine or processing operation. A limit switch in the exit chute automatically shuts off the equipment if parts back up from the subsequent operations. Total weight of the unit is about 4000 pounds, and it requires a floor space of only 3 by 8 feet.

Circle Item 105 on postcard, page 179

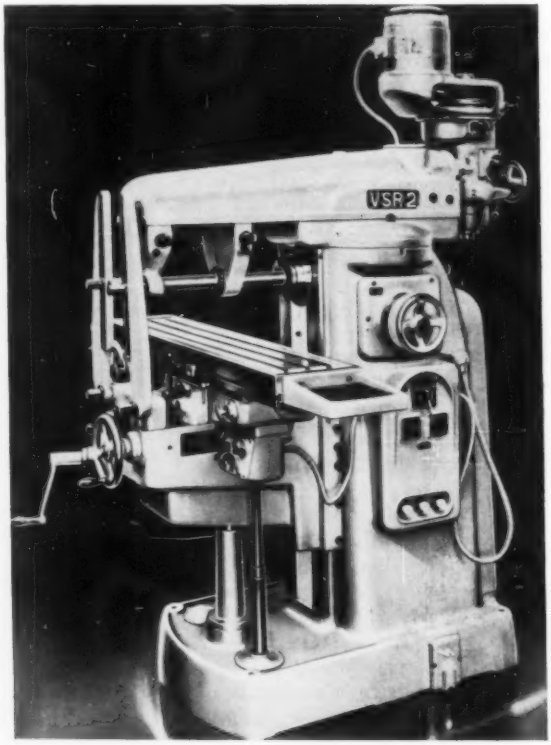
Morey Combination Milling Machines

A combination milling machine, designated the MOREY-RAM VSR2, has been introduced in this country from Italy by the Morey Machinery Co., Inc., New York City. This machine is said to effectively combine the functions of three different millers in one machine tool. Both vertical and horizontal spindles of this machine can be used simultaneously to mill the same part. The hardened and ground vertical spindle is powered by a 3 1/2-hp, two-speed motor that provides sixteen spindle speeds from 65 to 4750 rpm and has automatic power feed both up and down (with automatic safety stops) and an R8 Bridgeport or Hardinge taper.

The horizontal geared-head spindle has an ISA No. 50 taper and is driven by its own 5-hp two-speed motor, allowing 12 dif-



Automatic parts-handling unit made by Gear-O-Mation Division, Michigan Tool Co.



Combination milling machine introduced in this country by Morey Machinery Co., Inc.

ferent spindle speeds from 30 to 1400 rpm. The upper-ram arm allows a 360-degree horizontal swivel and the vertical spindle, a 180-degree cam-lock swivel.

The 48- by 10-inch work-table has an automatic longitudinal feed of 38 inches with preselective type table feeding rates of 1/2 to 22 inches per minute or rapid traverse of 100 inches per minute. This table will oscillate back and forth and can be used for surface grinding (with accessory grinding apparatus) when table stops are in place. A larger table, 55 by 12 inches, that allows an automatic longitudinal feed of 48 inches can also be supplied. The machine weighs approximately 4500 pounds, and is equipped with a 3-inch diameter lead-screw that runs in oil at all times.

Circle Item 106 on postcard, page 179

Alphil Resistance Spot-Welder

A precision roller-bearing ram, high-current electrical design, high speed, and ruggedness are features claimed for the Model A-R resistance spot-welders brought out by the Alphil Spot Welder Mfg. Corporation, New York City. These welders are specially designed for the sheet-metal, wrought-iron and wire-fabricating industries. The roller-bearing ram permits bind-proof precision alignment of the work and the application of positive pressure. An independent air valve brings the ram down for fine electrode adjusting.

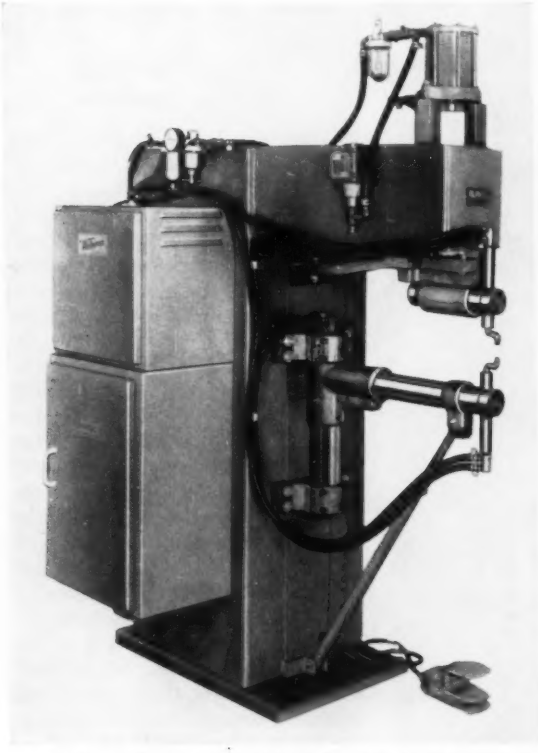
Current capacity is 75 kilovolts with silicone steel transformer that provides temperatures adequate for welding 16-gage commercial aluminum and 7-gage cold-rolled steel under control of an adjustable 8-step rheostat. Maximum short-circuit secondary rating is 26,000 amperes. A 2-stage foot switch allows selection of either manual or high-speed automatic operation. Speed is controlled by a high-speed weld timer circuit and an ignition contactor. The housing is all-welded 1/4-inch steel plate.

Circle Item 107 on postcard, page 179

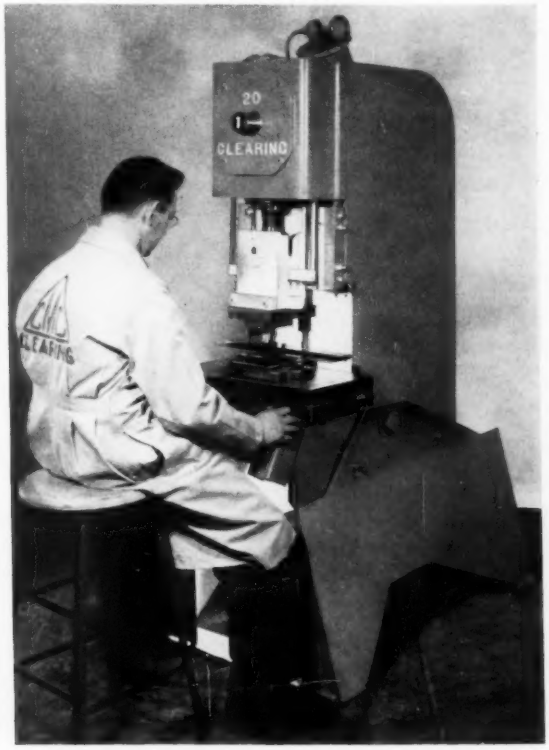
Presses with Torc-Pac Clutch and Brake

The Clearing Machine Corporation, Division of U. S. Industries, Inc., Chicago, Ill., has brought out a line of Torc-Pac open-back inclinable presses in 20-, 30-, and 45-ton capacities. These all-steel welded presses are equipped with air-friction clutches as standard equipment.

The high-speed drive components are remarkably compact and light in weight, a factor which increases the portability of these these machines. The use of a high-speed main motor (1800 rpm) is said to contribute to their low, competitive prices. The Torc-Pac press drive is a compact assembly of all of the working members in the drive and slide. This press drive consists of the motor and mount, sheave, belt, flywheel, clutch and brake, double reduction gearing, eccentric shaft, pitman, slide, and gibs. The entire mechanism can easily be removed from the frame as a single unit. This construction offers conven-



Alphil resistance spot-welder with roller bearing ram



Torc-Pac-equipped open-back inclinable press

ience and accessibility for maintenance. Complete drive assemblies are interchangeable among presses of the same tonnage.

The sub-assembly, consisting of the air-friction clutch, brake, and reduction gearing, is interchangeable among all Torc-Pac presses, regardless of tonnage, and easily removable. A single replacement clutch, brake, and gear assembly provide insurance against production delays. The Torc-Pac press drive units may be purchased separately. They are simple to mount in standard or custom frames. Six bolts hold the drive in place. A simple machined shoulder takes the operating load, and the drive can be operated in any position.

Circle Item 108 on postcard, page 179

Snyder Vertical Boring Machine

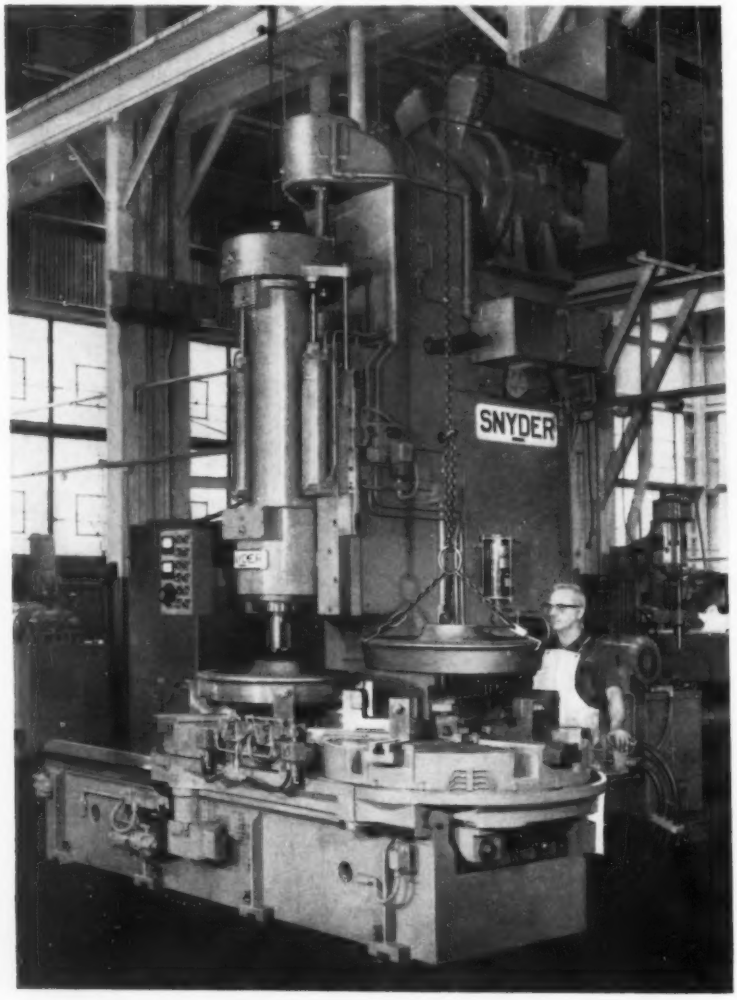
A vertical boring machine designed to use automation techniques for speeding up the production of heavy parts is now available from Snyder Tool & Engineering Co., Detroit, Mich. A part weighing up to 700 pounds can be loaded into a two-position, line-index type fixture while another part is being bored. The spindle of this machine is powered by a 75-hp motor provided with a variable-speed drive to accommodate a variety of bore sizes. Hydraulically operated five-jaw chucks permit the holding of parts of different diameters. A separate hydraulic power pack supplies power for operating the chuck, table, and spindle-feeding cylinders. A spindle 7 feet long is supported by two tapered roller bearings at the top and one at the bottom.

The illustration shows the machine set up for semi-finish boring cast- or forged-steel railway car wheels. In this operation, up to 11/16 inch of stock is removed from a 7-inch diameter bore in a single machining operation in seventy seconds.

Wheels with nominal bore sizes ranging from 6 1/8 to 7 3/8 inches in diameter are processed by adjusting spindle speeds and changing the special flanged boring-bars. Special two-step bars using throw-away, mechanically clamped, carbide inserts are employed for the wheel-boring operations.

The tools operate at a surface speed of 225 feet per minute and a feed of 1/16 inch per revolution without coolant. Automated equipment unloads and puts wheels into the chucks at each end of the table. Gross production is at the rate of forty-eight wheels per hour.

Circle Item 109 on postcard, page 179



Snyder vertical boring machine for processing car wheels

Edlund Gun Type Drilling Machine

A vertical gun type drilling machine, designated Model 2G, has been announced by the Edlund Machinery Co., Cortland, N. Y. This machine is designed for rapid, economical production of accurate straight and smooth holes. It is claimed that deep holes formerly requiring frequent withdrawal of the tool can now be drilled in one continuous feeding operation—even in materials that ordinarily work-harden during machining. Reaming can often be eliminated, since a finish of from 4 to 8 micro-inches can be obtained in most materials with the new equipment, and size can be held to within a few tenths of 0.001 inch in nearly all cases.

The new drilling unit is of the vertical type which lends itself to multiple operations, where one operator can use several spindles by loading one while the others are working. Also, one gun-drill-

ing spindle can be combined with standard drilling spindles on a common base, so that operations requiring one gun-drilled hole and one or more regular holes can be performed at the same time. Odd-shaped pieces which cannot be rotated can be drilled with the new Model 2G machine as the gun-type drill itself rotates.

The machine has an extra-heavy base as well as frame and arm construction, that, combined with high speeds, enables the operator to employ the latest carbide-tipped gun drills. The variable-speed drive permits use of the correct speed required to obtain best results with respect to finish and tool life.

The wide range of spindle feeds needed to meet any drilling requirement is available through a magnetic clutch which can be remote controlled and, if desired, coordinated with automatic cycling operations.

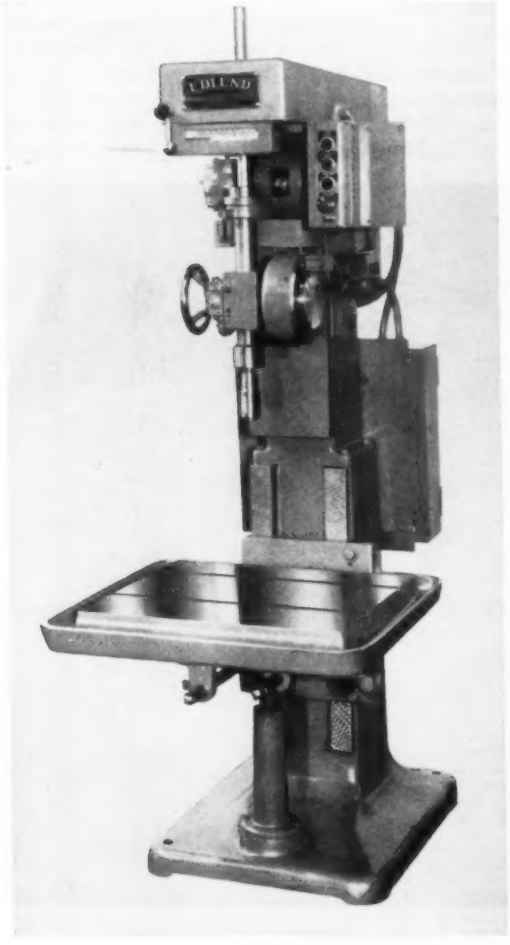
The machine will drill holes up to 5/8 inch in diameter and to a maximum depth of 7 1/2 inches, depending upon the size of tool and material. All types of materials including aluminum, cast iron, bronze, stainless, and all other generally available steels can be drilled.

Circle Item 110 on postcard, page 179

Milling Machine Added to Toolmaster Line

The line of Toolmaster milling machines manufactured by the Cincinnati Milling Machine Co., Cincinnati, Ohio, has been increased to four by the addition of the new No. 1-D machine. The design of the column, knee, saddle, and table is similar in all four machines of the line. The knee-saddle bearing is of the square-gibbed, center-guide design. Extra wide knee-to-column bearing is approximately equal to the full width of the knee. Manual feed is standard, with power cross- and table-feeds available as extra equipment. Electrical controls are built into a compartment at rear of column. Basic differences in the four styles will be found in the over-arm and motor-driven spindle head.

The spindle head of the 1-D Toolmaster is completely new. It is heavier than the spindle heads of the 1A and 1B styles, and is



Edlund gun type drilling machine

Cincinnati milling machine added to Toolmaster line

driven by a 1 1/2-hp motor as compared to a 1-hp motor used in the other three machines of the line. A No. 40 standard taper hole in the spindle and conventional key drive permit the use of existing No. 40 taper-shank cutters and collets. A built-in draw-in bolt with a unique locking arrangement facilitates the changing of cutters. The operator merely rotates the spindle (while speed series lever is in "neutral") to tighten the arbor shank. An interlock prevents the starting switch from being engaged while the draw-in bolt is locked.

The spindle is quill-mounted and has manual feed, with lever and fine handwheel feed controls. Power feed is available as extra equipment. This mechanism provides up and down feeds that are selected in three rates of 0.0015, 0.003, and 0.006 inch per revolution by means of a control knob. Spindle speeds are infinitely variable from 100 to 3800 rpm. A single-crank type control selects the high and low series of spindle speeds at the side of the head. Power is transmitted by a belt running on variable-pitch sheaves. A lever-operated brake stops the spindle in a few revolutions. The quill has an extra long movement range of 4 inches. Quill, clamp, scale, and pointer for vertical settings are part of the quill mechanism.

A large number of attachments and accessories are available, including an index-head, precision measuring equipment, and shaping attachment.

Circle Item 111 on postcard, page 179

Cross Transfer-matic for Boring Axle Housings Equipped to Assure Precision Location of Gear Centers

An arrangement of several precision finishing tools is featured in the latest Transfer-matic brought out by the Cross Company, Detroit, Mich. This machine, Fig. 1, is equipped to bore axle housings with their differential bearing caps assembled. In the finishing stations, the vertical boring unit first faces the shoulder and then bores the diameter for the outer pinion-shaft bearing. The same unit next bores the diameter and faces the shoulder for the inner bearing of the pinion-shaft (see Fig. 2). Greater accuracy with respect to concentricity and squareness of the shoulders is obtained between the two bearing bores by performing all of these operations with the same spindle. Simultaneously, two opposed horizontal units back-bore the differential bearing diameters. This arrangement has been developed to insure the most precise center relationship between the vertical and horizontal bores of the finished part.

The differential bearing diameters are rough-bored with multiple-blade cutters in the fourth and fifth stations of the machine. The lift-and-carry transfer mechanism lowers the parts over the cutters, which are loosely supported by blade-like bearings. An arbor is then inserted from one side of the part to locate and drive the cutter and feed it to the required

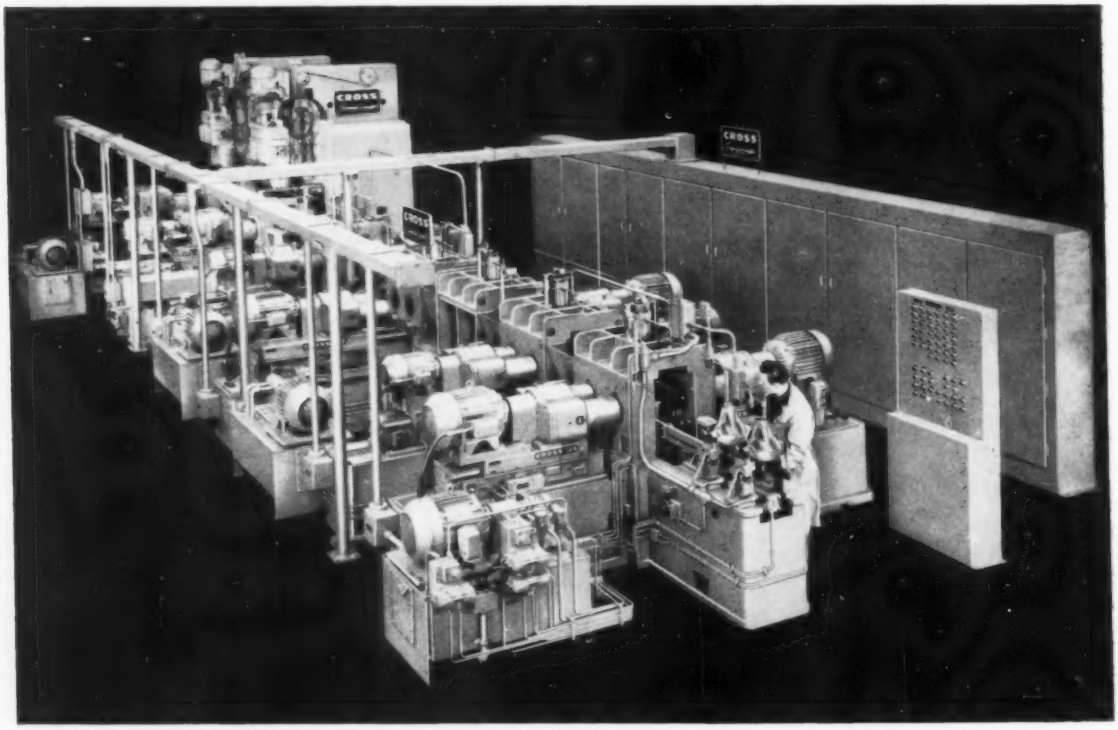


Fig. 1. Transfer-matic built by the Cross Company for finishing rear-axle housings in which the differential bearing caps have been assembled

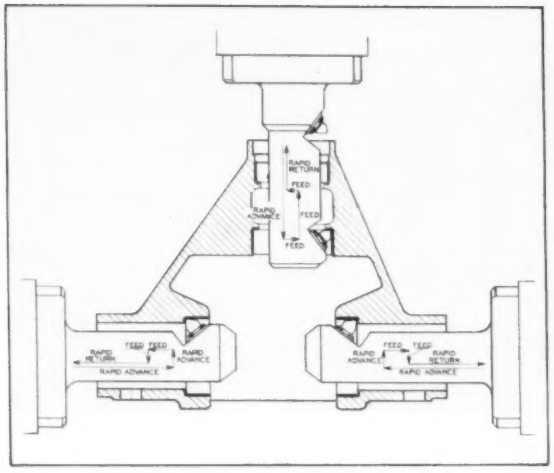


Fig. 2. Diagram showing tool motions of Transfer-matic

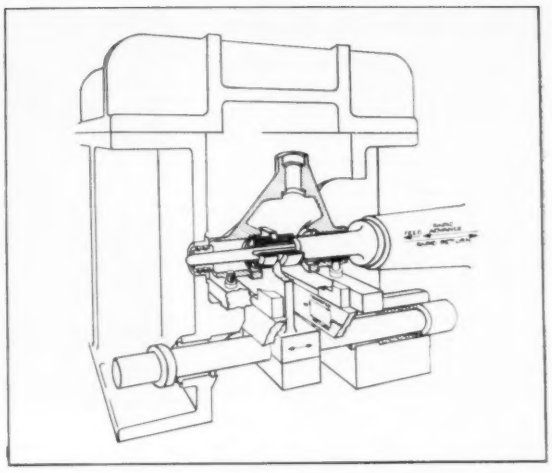


Fig. 3. Tooling for rough-boring differential bearing

depth (see Fig. 3). This arrangement is necessary because the tubing bore outside of the bearing bore is of smaller diameter.

The Cross machine has a rated capacity of ninety pieces per hour at 100 per cent efficiency. Each cycle produces two finished axle housings.

Other features of the Cross Transfer-matic include: the interchangeability of all standard and special parts for easy maintenance; construction to JIC standards; hardened and ground ways; hydraulic feed; rapid traverse; and a complete automatic lubrication system.

Circle Item 112 on postcard, page 179

Automatic Double-Crank Dieing Machine

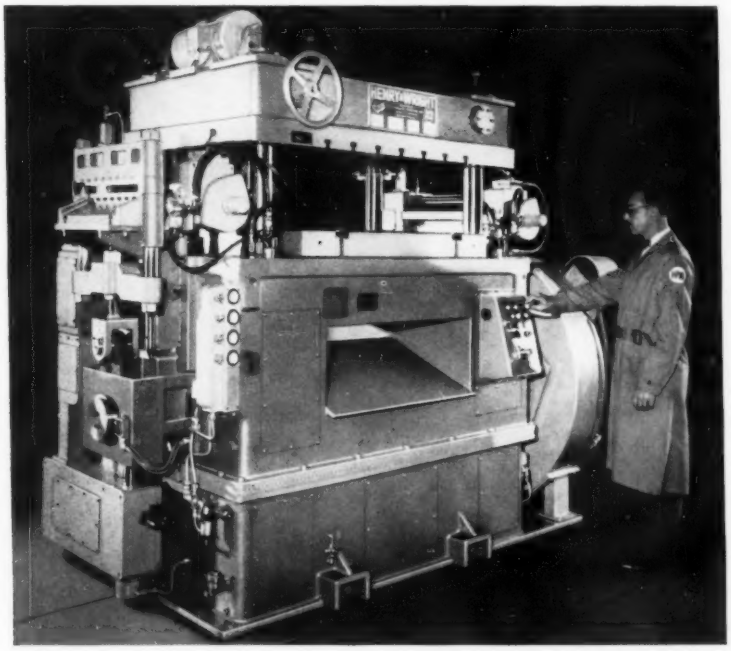
A 100-ton automatic Henry & Wright double-crank dieing machine has been built for a manufacturer of electric sweepers by the Hydraulic Press Mfg. Co., a Division of Koehring Co., Mount Gilead, Ohio. The double-crank arrangement that supports the upper cross-head of the press at both ends provides the rigidity and strength required for off-center loading flexibility in approximately the ratio of die-bed area to press capacity.

The characteristics of the underdrive system—high-speed operation; accurate alignment; low center of gravity; and a pulling, rather than a pushing stroke—are combined with a double crank to extend the range of work that can be handled through progressive stamping.

A dampener gasket in the form of a neoprene - cork - neoprene sandwich separates the upper and lower base of the machine for the purpose of reducing the amount of vibration transmitted to the floor. This machine, equipped with progressive dies, makes it possible to combine many complex stamping and forming operations into one progressive production sequence.

In operation, coil or sheet metal is fed through roll feeds to a series of die stations where piercing, blanking, forming, and other operations are performed, a finished part being produced at each stroke.

Circle Item 113 on postcard, page 179



Henry & Wright 100-ton automatic double-crank dieing machine built by the Hydraulic Press Mfg. Co.

Trebel Balancing Machine

A new type production balancing machine, designated the Trebel Model AEH 100c, that indicates dynamic and/or static unbalance by both the single-resultant and coordinate-system methods, has been introduced by the American Trebel Division of the Kurt Orban Co., Inc., Greenwich, Conn.

No graphs or sildes are required when using this machine. The conversion is made directly by the machine's electronic indicator unit that shows the correction weight required in each plane by means of a microammeter and simultaneous color-coding lights. Points of correction from unbalance can thus be predetermined in the design stage, and provisions can be made for quick and safe removal or addition of weight. This machine will handle parts weighing up to 220 pounds.

Circle Item 114 on postcard, page 179

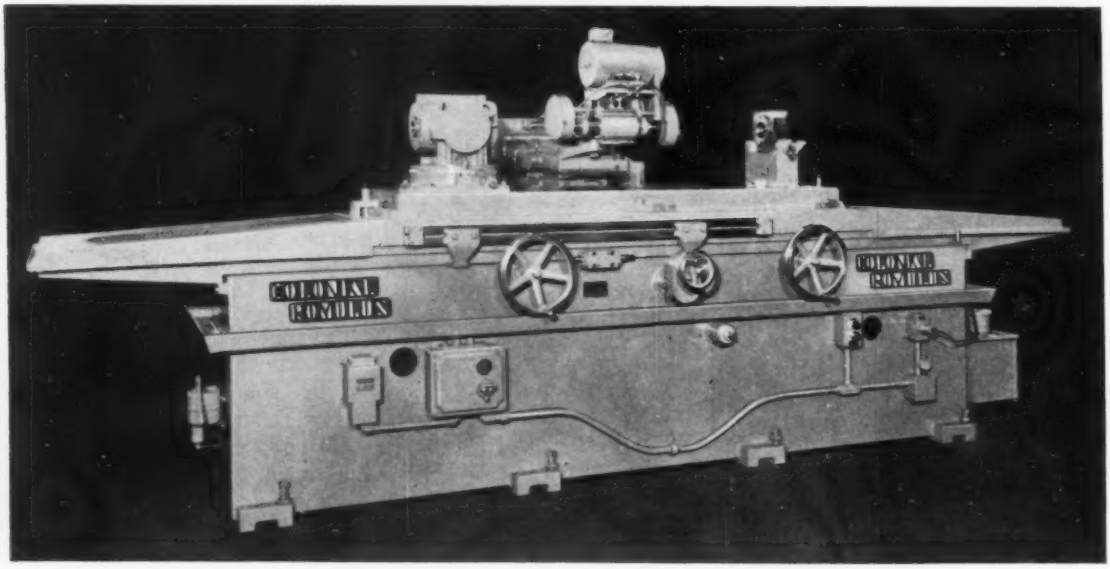
Trebel production type balancing machine introduced by American Trebel Division of the Kurt Orban Co.

Universal Tool and Cutter Grinder

A universal tool and cutter grinder designed for economical sharpening of large, heavy milling cutter assemblies to their original form and cutting effectiveness has been built by the Colonial-Romulus Division, Colonial Broach & Machine Co., Detroit, Mich. It is built to enable a plant to do its own milling-cutter assembly sharpening with maximum ease and precision, eliminating time lost for cutter disassembly and the usual cumulative errors of separate sharpening and reassembly. Also, it lessens the need for carrying expensive cutters as spares or having them resharpened by the cutter manufacturer. The Colonial machine will grind either high-speed steel or carbide-insert milling cutters.

Straight and helical flutes, radial and end faces of cutters can be ground, and cutters with cylindrical, tapered, or contoured forms can be resharpened. Accuracy of the unit is held to 0.001-inch runout of all working surfaces in grinding outside diameters up to 18 inches. In grinding tapers, the machine will hold the work to the correct angle within 0 degree 5 minutes. It is designed particularly for use in the aircraft and missiles field.

For the grinding and inspection operations, the cutter to be sharpened is held as nearly as possible in its actual working position.



Colonial-Romulus universal tool and cutter grinder

Taper-shank cutters in diameters from 4 to 10 inches with flute lengths up to 15 inches; face-mounted cutters in diameters from 4 to 18 inches with flute lengths up to 9 inches; and arbor-mounted cutters in diameters from 4 to 18 inches with flute lengths up to 36 inches weighing up to 1000 pounds are typical of the cutter assemblies handled.

The double-end grinding spindle is motor-driven and can be operated at a speed of 3450 or 6000 rpm. The motor is a 2-hp, 60-cycle, 440-volt alternating-current type with controls located on both the front and rear of machine. The grinder uses a floor space 7 by 14 feet and weighs approximately 9500 pounds.

Circle Item 115 on postcard, page 179

High-Speed Automatic Welding Process and Equipment

An automatic high-speed welding process and equipment for its application have been announced by the Lincoln Electric Co., Cleveland, Ohio. The equipment arc-welds steel at speeds ranging up to 300 inches per minute. The process, called "Innershield," uses a new type of flux-containing, coiled wire electrode that produces a vapor shielding for an open arc, in contrast to the completely flux-covered arc of submerged arc-welding and the open-arc gaseous shielding of coated manual electrodes. The process will handle lap welds in 16-gage material to butt welds in 1/2-inch plate.

No fluxing or shielding agents are added to the arc from external sources, all materials being integrally contained in the electrode. This elimination of externally applied flux and shielding agent, combined with the equipment's control features and high rates of feed and speed, permit exceptionally high welding speeds.

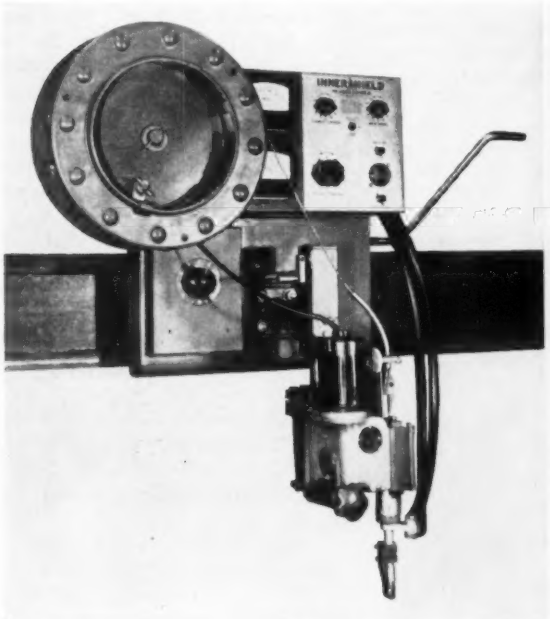
Speeds in lap-welding 14-gage material in the horizontal position average 150 inches per minute but under ideal conditions may range up to 300 inches per minute. Lap welds in heavier material, such as 3/16-inch plate, range around 100 inches per minute. Since the process eliminates granular flux, there is no abrasive flux material to cause wear and operating difficulties in fixtures or machinery.

Equipment for the process includes a new welding head that controls electrode feed and a motor-generator power source that supplies 400 to 1000 amperes welding current. The control circuit for the welding head is readily adaptable to machines and fixtures for high-volume production welding.

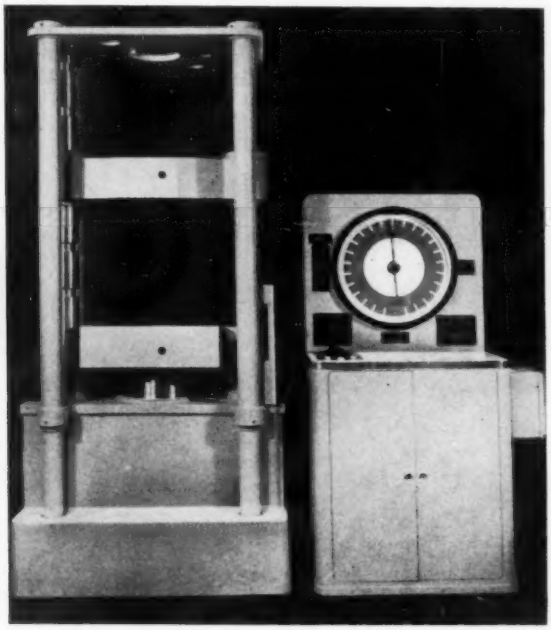
Circle Item 116 on postcard, page 179

150,000-Pound Mechanical Testing Machine

A 150,000-pound universal testing machine, said to be the largest single-screw mechanical type ever made, has been developed by the Electronics and Instrumentation Division, Waltham, Mass., of the Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa. The machine is of ball-and-screw design and can apply tension and compression or alternating loads to a specimen. It is the first mechanical tester of this capacity capable of providing facilities for both standard testing and alternating-load work. All measurements are taken by SR-4 devices, designed to make the highest possible accuracy available for all test setups. Operating advantages include:



Automatic head, controls, and self-propelled carriage for "Innershield" welding



Baldwin-Lima-Hamilton mechanical testing machine with ball-and-screw arrangement

positive head positioning; easily controlled, constant or variable head speed; direct reversibility for tension or compression; and ability to cycle both load and strain tests.

The machine can test almost any material or part which is subjected to sustained or alternating loads and strains. Such parts would include those used in aircraft, vehicles, marine craft, high-speed turbines, and industrial machinery. The testing space is 30 inches wide with a vertical opening of 48 inches. Both can be increased, however, on special orders.

Circle Item 117 on postcard, page 179

Kaufman rapid-indexing unit set up on two-spindle tapping machine

Rapid-Indexing Unit for Two-Spindle Tapping

The Kaufman Mfg. Co., Manitowoc, Wis., has brought out a fast-indexing unit with a 330-pound dial that indexes 90 degrees smoothly and without shock in as little as 0.7 second. This unit uses a control that is adjustable for speed and dial load. The illustration shows the unit set up on a double-spindle machine equipped for tapping 3/4-inch diameter, 4-pitch threads in steel parts.

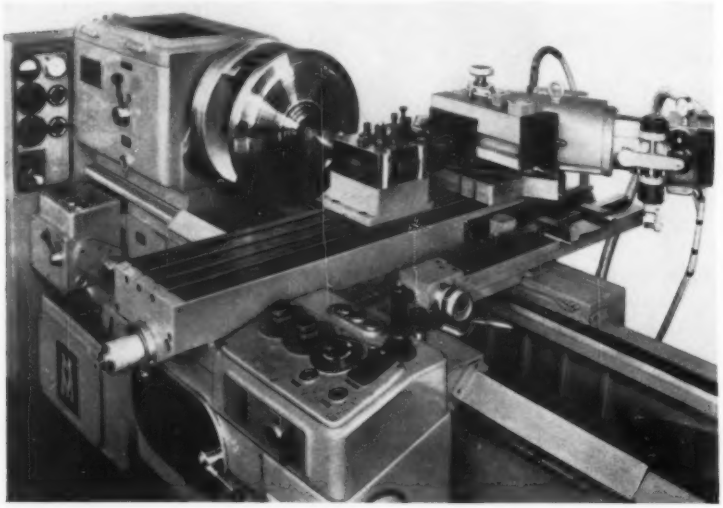
Circle Item 118 on postcard, page 179

Electromatic Lathe with Automatically Controlled Constant Cutting Speed

The Cosa Corporation, New York City, is introducing into the United States a German-made Electromatic lathe with the spindle revolutions automatically controlled by the tool travel. Constant cutting speed can be maintained accurately on this lathe even on copy-profiling jobs having varying contours. With this control it is claimed that up to 45 per cent less machining time is required. It maintains a constant metal-removal rate within a diameter ratio of 7 to 1; uniform turned-surface finish over the entire diameter range of the part; and greatly increased tool life as a result of maintaining the proper cutting speed throughout each job.

The setting for the desired cutting speed is made on a pre-selector dial. This electronic control keeps the cutting speed constant by stepless regulation of the spindle speed. Switch-over from constant surface cutting speed to constant spindle speed in revolutions per minute can be made at any time.

The machine includes eight 7-to-1 ratio speed groups with cutting speeds ranging from 20 to 1800 feet per minute. For production turning of work-pieces with wide variations in diameter, the machine will operate alternately with either constant cutting speed or constant spindle speed. Other features include: independently fed front and rear tool-slides on the saddle, automatic feeding of upper tool-slides, and special hydraulic copying device instead of rear upper slide. Special designs are available on request.



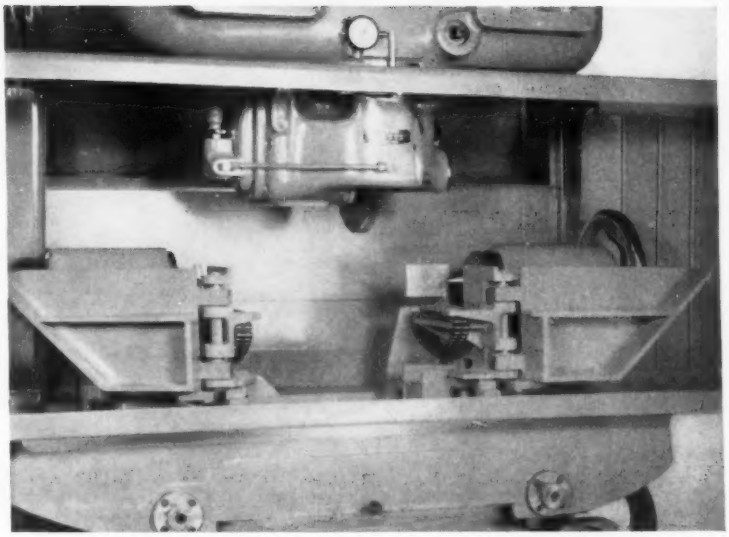
Electromatic lathe introduced in this country by the Cosa Corporation

Circle Item 119 on postcard, page 179

Roller-Chain Work-Loading Rail for Red Ring Gear-Shaving Machine

A Red Ring roller-chain work-loading rail designed to simplify the loading of heavy gears in rotary gear-shaving machines has been developed by the National Broach & Machine Co., Detroit, Mich. This equipment has been developed to solve the problem of rolling a large gear into mesh with a shaving cutter while maintaining proper forward position for entry of the head and tailstock centers.

The gear is first lowered on to the loading rails and engages rollers supported by a conventional roller chain. The chain rollers permit freedom of straight-line, back-and-forth movement. The five rollers attached to the chain permit free rotary motion of the gear, which can be easily advanced or retracted while being rolled into mesh with the shaving cutter. When the gear is in proper mesh, the tailstock center is advanced with a handwheel, and the work is in position for the shaving cycle. The roller-chain work-loading rail design can be adapted to suit a variety of rotary gear-shaving machines where large, heavy gears are finished by the shaving process.

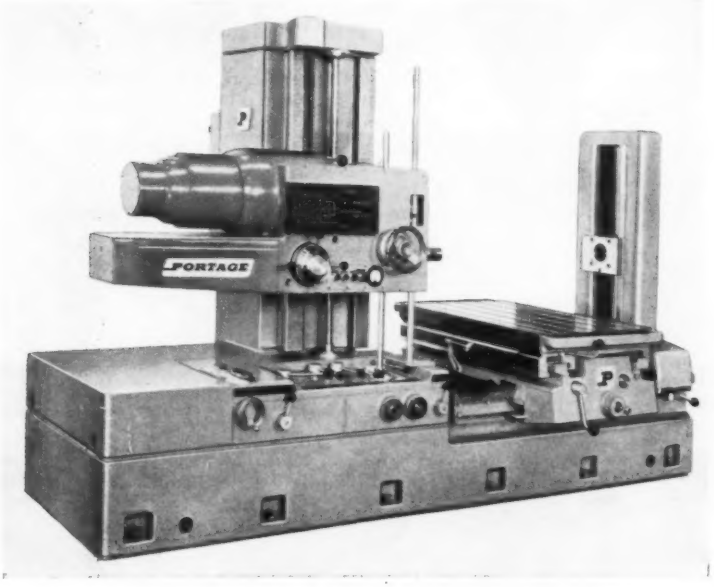


Red Ring roller-chain work-loading rail mounted on a rotary shaving machine

Circle Item 120 on postcard, page 179

Portage Horizontal Milling, Drilling, and Boring Machine

A versatile, multiple-purpose horizontal milling, drilling, and boring machine designed for economical, rapid handling of work-pieces of many sizes, shapes, and materials has been built by the Portage Machine Co., Akron, Ohio. The construction and control arrangement of this machine is designed to permit fast positioning and handling of both long- and short-run lots, at minimum cost. Power, spindle speeds, and infinitely variable feed are selected to provide the best combination for operations with large or small cutting tools. Strength, rigidity, and precision are built-in features that make the machine suitable for toolroom use, general production, or roughing work.



Horizontal multiple-purpose milling, drilling, and boring machine

Separate spindle- and feed-drive motors provide maximum power for the cutting tools at all speeds and a flexibility of feed motions for economical tooling. Infinitely variable feed-rate adjustment permits control of surface finish and chip load. The feed rate is shown on a dial and can be pre-set before engagement of the head, table, or saddle feed. Feed rates can be changed during feeding, even with the cutting tool under load. An extra low-range feed shift is provided on the saddle feed for fine boring. The saddle has a feed range of from 30.0 inches to 0.03 inch per minute. An exclusive Portage double rack-and-pinion, with heavy-duty double-row ball-thrust bearings on the spindle provide for in and out feeding of the 3-inch spindle.

(Continued on page 176)

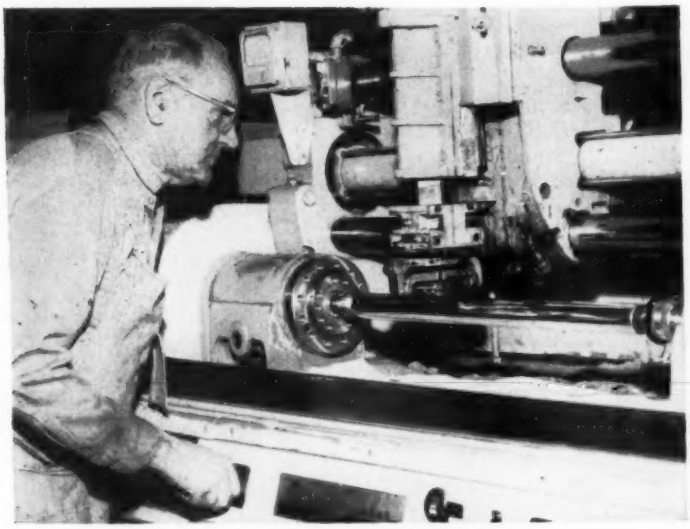
Red Foucault grinds rolls

Louis "Red" Foucault, general foreman of the roll grinding department at Allegheny Ludlum's Wallingford Steel Co., has been a leader in the development of new roll grinding techniques for 30 odd years. Recently he has been working closely with Bay State's Fred Lee and it has really paid off for all concerned.

BAY STATE
WHEELS of PROGRESS

BAY STATE ABRASIVES

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Bristol, Conn., Chicago, Cleveland, Detroit, Pittsburgh.
Distributors: All principal cities.



This 29¼" x 2¾" roll was rough-finished with a 600 grit Bay State honing stone. Here operator Lyman Tyler is giving it the final finish with the amazing 2600 grit stone on a Gisholt Superfinisher.

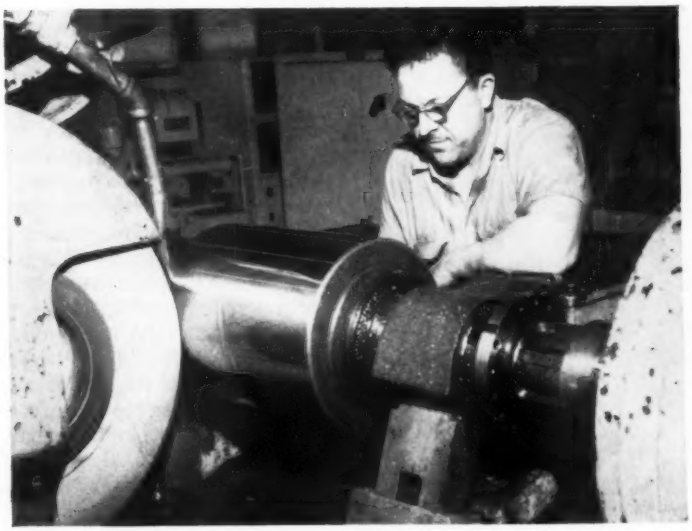
to 50 millionths tolerance at Wallingford Steel

It's one thing to talk about millionths when you're honing a piece of steel the size of your finger. But when you want to grind 33" strip-finishing rolls more than two feet in diameter to tolerances of 50 millionths concentricity... parallel end to end ...you get into a totally different kind of grinding.

And that's exactly what Red Foucault of Wallingford Steel did get into with Fred Lee, Manager of the Bay State Bristol (Conn.) office.

Two ten thousandths had been the closest tolerance possible until Lee came up with a 2600 grit stone that had never been tried on strip-finishing rolls before. *Result:* Rolls that are 400% closer to perfect concentricity with finishes of #1RMS or under . . . a new performance record for Red Foucault . . . and the smoothest stainless steel strip (finishes as fine as #4RMS) ever produced for manufacturers of cutlery, automobiles and what have you.

You'll find your own Bay State representative ready to go to infinite pains to help solve your particular grinding problems and, like Fred Lee, not afraid to try new techniques. *Better grinding at lower cost . . . that is his business.*



In preparation for final honing operation, operator John Bakamas gets a #1RMS finish (and under) on a 13" x 13" roll with a Bay State levigated aluminum oxide resinoid bonded wheel.

The headstock is self-contained, with a flange-mounted, dynamically balanced, 7 1/2-hp motor driving the spindle. Direct-operating levers shift gears on splined shafts to provide twelve speeds in geometrical progression ranging from 26 to 1535 rpm.

The feed drive for movement of the head, table, and saddle is by a separate 3-hp motor in the bed, and is infinitely variable for selection of optimum feed rates—0.300 inch to 30 inches per minute for the head and table; and 0.030 inch to 30 inches per minute for the saddle. Micrometer adjustable dials are provided for movement of head, table, and saddle to exact positions. Dials are graduated in 0.001 inch with full-turn movement of 0.100 inch. With low-range shift engaged to the saddle, the dial has a full-turn movement of 0.010 inch with each graduation on the micrometer scale equal to 0.0001 inch.

On the head are buttons for "Run" and "Jog" of the spindle in either direction, "Spindle Stop," and "Emergency Stop" for the machine. On the bed are buttons for "Start," "Jog," and "Stop" for the feed motor.

The spindle nose has a No. 5 Morse taper. Continuous feed travel of the spindle is 24 inches. The table has a work surface 28 by 44 inches and a cross travel of 30 inches. Saddle travel with end support is 24 inches, and without end support, 31 inches. Vertical travel of headstock is 30 inches.

Bed width over the hardened ways is 30 inches and over the hardened saddle ways, 23 3/8 inches. The length of the hardened saddle ways is 47 inches. The machine is 10 feet 7 inches long, 4 feet 8 inches deep, and 7 feet 2 inches high, with a shipping weight of approximately 14,500 pounds.

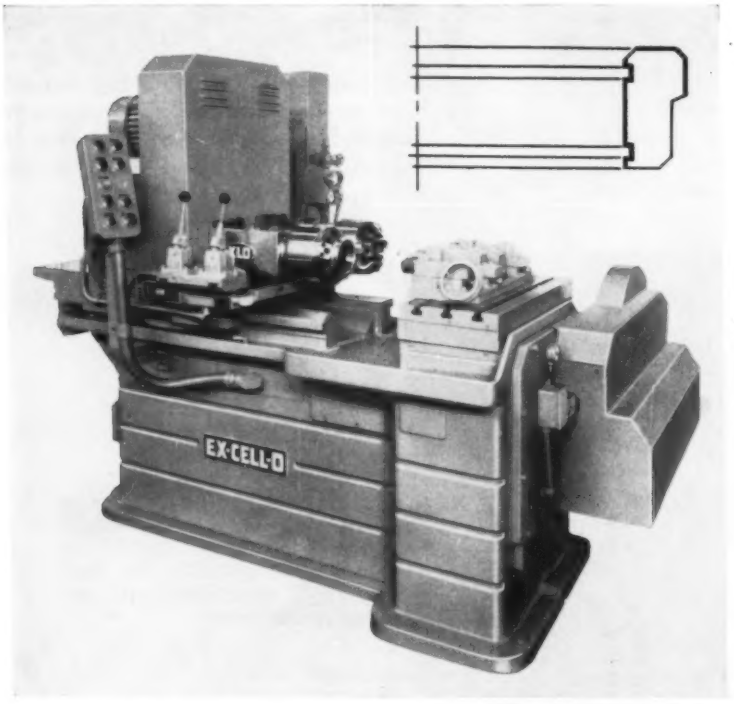
Circle Item 121 on postcard, page 179

Ex-Cell-O Cam Boring Machine Equipped to Process Two Parts Simultaneously

A two-spindle, Style 312, cam boring machine built by the Ex-Cell-O Corporation, Detroit, Mich., has been equipped to perform similar operations on two automobile-transmission bearing races simultaneously. Six operations are performed on each part. They include precision facing, chamfering, turning, boring, and two-position grooving indicated diagrammatically in the upper right-hand corner of the illustration. The steel components are more than five inches in diameter and are held to close limits on critical dimensions.

The cross-slide has two sets of tools, each with four tools that engage the parts during the machining cycle. The first tool faces the front surface, chamfers the outside edge, and turns the outside diameter. The second tool bores the inside diameter, holding the work to size within limits of plus or minus 0.001 inch. The third and fourth tools plunge-cut the grooves. Three-jaw, air-operated chucks are used. Production runs as high as 140 parts per hour.

Circle Item 122 on postcard, page 179



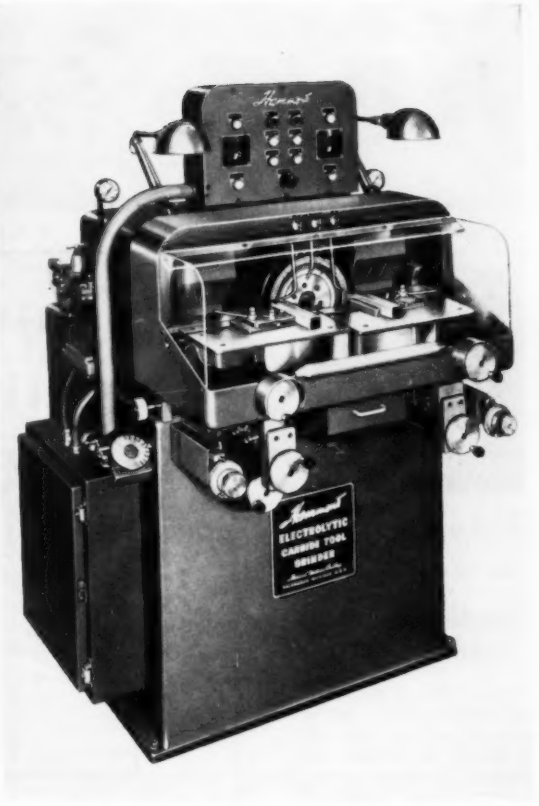
Cam boring machine built and equipped by the Ex-Cell-O Corporation for processing two bearing races simultaneously

Dual-Frequency Induction Heating Generator

The addition of a dual-frequency generator to its line of high-frequency induction heating units has been announced by Lepel High Frequency Laboratories, Inc., Woodside, N. Y. This generator is rated at 10 kw of output power. The lower frequency range is 250 to 600 kc. The higher frequency range is approximately 2 to 5 megacycles. It provides flexibility in heating operations where frequency may be important without changing the basic features of the standard generator. Also, it eliminates the necessity of purchasing two separate generators. Megacycle frequencies are ideal for heating very thin parts and semi-conductor materials and for superficial heating.

The megacycle tank circuit components are located in the lower portion of the cabinet, and the standard-frequency tank circuit components, in the smaller cabinet on the top. Both circuits use the same oscillator tube and direct-current power supply. Each

Lepel dual-frequency induction heating generator



Hammond duplex oscillating type carbide tool grinder

tank circuit has a separate grid control, permitting proper adjustment for grid drive requirements. For experimental work, the mega-cycle frequency range can be altered by using capacitors of different values in the tank circuit.

Circle Item 123 on postcard, page 179

Hammond Duplex Oscillating Type Carbide Tool Grinder

An SCE-10 duplex oscillating type carbide tool grinder equipped with a diamond wheel 10 inches in diameter has been developed by Hammond Machinery Builders, Inc., Kalamazoo, Mich. The spindle construction of this machine is designed for heavy-duty and smooth operation, with large pre-loaded duplex bearings, dynamic balancing, and precision fitting. The spindle nose is tapered to insure true mounting of a flanged wheel. The spindle oscillates on tapered roller bearings. For electrolytic operation, it is insulated from the machine and is equipped with a 600-ampere capacity power pick-up. Wheel oscillation is controlled by handwheels, the stroke length ranging from 0 to 1 1/2 inches for tools up to the 2-inch size. The wheel oscillating frequency ranges from 0 to 115 strokes per minute.

The machine has two tables mounted on ball-bearing ways which are arranged so that grinding can be done on both sides of the diamond wheel at the same time. Also, one table can be loaded while the other is in the grinding position. Angular setting with handwheels ranges from 10 degrees above to 25 degrees below horizontal with no movement of the tables toward the wheel. Each table has an area of 10 1/2 by 15 1/2 inches, including the sliding wings.

Each table is actuated by an air cylinder equipped with air-pressure gage, solenoid valve, and filtering and lubricating equipment. The amount of infeed is determined by a micrometer screw with hardened stops and a dial calibrated to 0.001 inch. The grinding time is controlled by an electric timer calibrated in seconds, which automatically retracts the table at the end of the grinding cycle. The cycle is started with a push-button and can be retracted at any time by the same means. A range from low to high work-point pressure is provided by a handwheel-controlled spring which variably resists the air cylinder. Grinding pressure is determined by the amperage shown on the power-pack ammeter. A fixed stop prevents table contact with the wheel, and a lock permits holding the table in fixed position during set up. Each table is equipped with a compound protractor vise, and special tool-holding fixtures can be provided as extra equipment.

Circle Item 124 on postcard, page 179

(This section continued on page 184)

RB&W FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

Technical-ities

By John S. Davey

Selecting the right grade of nuts

"Workhorse" among nuts is the standard "FINISHED" series. It gives good seating area; sufficient height to sustain high thread tension; enough wall thickness to control elastic nut dilation under load.

"HEAVY" nuts are wider than "Finished" nuts in *all* sizes by only ⅛" across flats. Thus, their value diminishes as size increases. Most effective in ½" to 1½" range, they satisfy applications involving excessive clearance holes, unusual loads, and certain boiler codes.

MATERIALS? The regular carbon nut steel (non heat treated). It makes nuts strong enough to pull bolts beyond yield point, lets threads distribute load to avoid stripping.

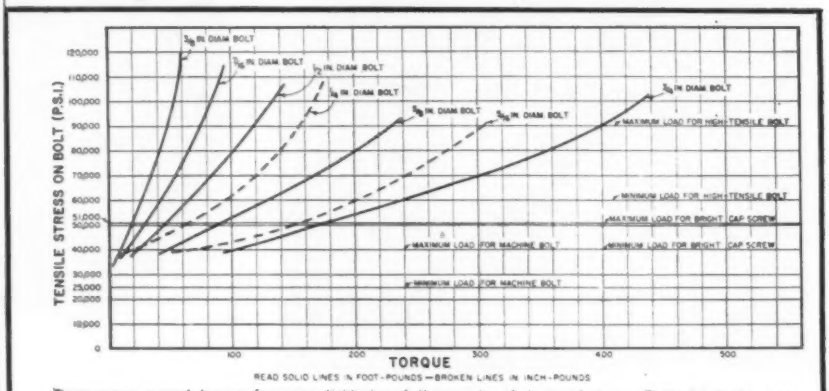
NUTS WITH "SPECIAL" FUNCTION

JAM NUTS are made for position locking. Use of two together forms a superior and economical locking device. When used to lock a regular nut, jam nut should be adjacent to work surface. Otherwise, the jam nut takes the load — a job it wasn't designed for.

Use a 2H NUT where high temperatures call for stability.

HIGH NUTS are used for shackle, U and tractor pad bolts. They're furnished only in fine threads, therefore, and hardened. More to be recommended are *coarse thread* finished nuts.

Tightening up fasteners tightens down on costs


TENSILE STRESS ON BOLT (P.S.I.)
TORQUE
READ SOLID LINES IN FOOT-POUNDS—BROKEN LINES IN INCH-POUNDS
MAXIMUM LOAD FOR HIGH-TENSILE BOLT
MINIMUM LOAD FOR HIGH-TENSILE BOLT
MAXIMUM LOAD FOR BRIGHT CAP SCREW
MINIMUM LOAD FOR BRIGHT CAP SCREW
MAXIMUM LOAD FOR MACHINE BOLT
MINIMUM LOAD FOR MACHINE BOLT

These curves suggest torques for proper tightening of three grades of standard fasteners. Tightening to the upper limits delivers more of the holding power paid for, and assures stronger joints. Dropping below minimum values wastes fastener strength, invites loosening and failures. These curves are reproduced in RB&W Booklet DC-1.

It pays to go the limit in tightening bolts. Not only is it more economical, but safer too. For strength of a rigid connection depends on *residual tension* rather than on how strong the bolts are. Applying this fact can help avoid cost penalty.

EXAMPLE:

Blueprint specifies alloy bolts with strength of 145,000 psi. But assembly specification calls for tightening to what has been found an adequate pre-loading . . . only 30,000 psi. This wastes the fastener's capacity. It provides no more joint-strength than supplied by a *far more economical* RB&W bright cap screw tightened to same pre-load. It would be better to switch to the lower grade, or reduce size of the premium grade fastener.

REDUCING SIZE ALSO SAVES

A fastener's holding power is the same as its pre-load, or residual tension. So long as it permits tightening to the required pre-loading, the bolt can be small as possible.

EXAMPLE:

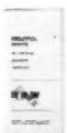
Design requires fasteners with safe load capacity of 20,000 lbs. Bright cap screws of ¾" size will do it; but so will ⅝" RB&W High Strength Bolts — *at less cost*. Actually, for the same holding power as in $1.00 worth of high tensile fasteners, $1.50 worth of bright cap screws are required.

PRODUCTION BENEFITS

Along with direct savings, smaller bolts mean smaller holes to drill or tap. Smaller holes often allow reduction in size of fastened members.

Talk to an RB&W fastener expert at the design stage of your product. He can help you cut costs without cutting joint strength.

Meanwhile, send for helpful booklet DC-1.. Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, New York.



Plants at: Port Chester, N.Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

For more information fill in page number on Inquiry Card, on page 179

PRODUCT INFORMATION SERVICE

Use postage-free Business Reply Cards for further information
On New Catalogues described in this issue of MACHINERY
On New Shop Equipment described in the editorial pages
On products shown in the advertisements

NEW CATALOGUES

ROLLING MILLS—Fenn Mfg. Co., New Road, Newington, Conn. 32-page catalogue FRM-58, presenting the Fenn Standard Line of rolling mills. Included is a complete section on mills for laboratory and advanced development, wire-flattening mills, and a complete line of related accessories. Copies are available by sending your name and title on company letterhead to J. H. Charpentier, sales manager.

AIR-GAGING CARTRIDGES—Sheffield Corporation, subsidiary of Bendix Aviation Corporation, Dayton 1, Ohio. Catalogue PGC-58-1, describing where and how to use Plunjet air-gaging cartridges in single- and multiple-dimension gages and inspection fixtures. Request this catalogue on your company letterhead.

STEEL PROPERTIES—Haynes Stellite Co., Division of Union Carbide Corporation, Literature Distribution Section, Long Island City, N. Y. 40-page booklet featuring the investment-cast properties of eight stainless and four low-alloy steels. The stainless steels include Types 310, 316, 347, 410, 431 low-carbon, 431 high-carbon, and 440C. The low-alloy steels cover 4130, 4140, 6150, and Haynes 1000 steel. These steels have been especially selected for their ability to meet a wide range of wear, corrosion, high-temperature, and structural problems. They are also very adaptable to the investment-casting method. 1

DRAFTING ROOM—Graphic Reproduction Division, Eastman Kodak Co., Rochester, N. Y. Bulletin outlining ways in which Kodagraph Reproduction Materials can provide short cuts and savings in reproduction departments, drafting rooms, and in the field. Entitled "Short Cuts and Savings with Kodagraph Reproduction Materials," the 12-page booklet diagrams seven applications for the materials: to protect original drawings, simplify print distribution, restore old and worn drawings, reproduce blueprints and direct-process prints, speed revision of drawings, permit combining of standard designs, and save drafting time with photodrawings. 2

MACHINE TOOLS—Walker-Turner Division, Rockwell Mfg. Co., Pittsburgh, Pa. Brochure containing a brief description and outline of specifications for the complete line of Walker-Turner's "light-heavyweight" machine tools. According to the bulletin, these tools combine the advantages of machine tools—rugged construction, precision accuracy, high production—and power tools—low cost, simplicity of setup and operation, versatility and portability. 3

ROLLER BEARINGS—Messinger Bearings, Inc., Phila., Pa. 64-page catalogue detailing the various types of radial and roller bearings which they design and manufacture, with complete information on sizes, capacities, typical applications, etc. The catalogue also contains data on load ratings and bearing life, with equations for figuring these two factors. The book is illustrated with diagrams and photographs. 4

TOOLING DIRECTORY—National Tool & Die Manufacturers Association, Cleveland, Ohio. 1958 Directory of Special Tooling Services offered by NTDMA members. The 76-page, pocket-size directory lists more than 1000 contract tool and die plants throughout the United States and Canada. Information given includes company name, address and telephone number; name of individuals to contact; and the specific products and services offered by each association member. These include dies, cutting tools, machining services, etc. 5

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HUB DESIGN—Cullman Wheel Co., Chicago, Ill. Bulletin No. 201 featuring all-steel Weld-On-Hub designed for foolproof assemblies of sprockets, pulleys, sheaves, gears, couplings, and other industrial equipment. The new Weld-On-Hub is said to be easily adaptable to various shaft assemblies without increasing the over-all length of the product itself. . . 6

COOLANT APPLICATORS—Mechanical Appliance Co., Mfg. Division, Chicago, Ill. Catalogue sheet No. 50, describing two "Squirt" coolant applicators which eliminate the old coffee can and brush, thus freeing both hands for other operations. It dispenses proper amount of coolant, where and when you want it, automatically, by the down stroke of the spindle, with no electrical or air power needed. 7

BUYER'S GUIDE—Joseph T. Ryerson & Son, Inc., Chicago, Ill. Bulletin 12-10, featuring simplified selection chart which provides data such as characteristics, size range, response to fabrication, and relative cost of seamless and welded, mechanical and structural, carbon-steel tubing. Condensed information also is given on stainless-steel and aluminum tubing and pipe, and plastic pipe. 8

HARDNESS TESTER—Wilson Mechanical Instrument Division, American Chain & Cable Co., Inc., New York City. 2-page data sheet TT-58, describing their new Model TT Rockwell TwinTester, a combination Rockwell and Rockwell Superficial hardness tester which was designed for use in laboratories, tool departments, small-lot metal jobber shops, etc. The data sheet lists operating features, standard equipment, optional accessories, and price information. 9

PRESSES—E. W. Bliss Co., Press Division, Canton, Ohio. 4-page brochure illustrating a line of deep-throat, high-speed presses. It completely outlines the dimensions and capacities of eight bench- and floor-model presses ranging in capacity from 4 to 60 tons with speeds of 90 to 195 strokes per minute at greater distances from the edge of large, wide sheets. 10

VALVES—Ross Operating Valve Co., Detroit, Mich. 20-page condensed version of the 1958 catalogue recently published by the company, supplying a quick valve reference, and introducing small industry to air power. To facilitate easy reference, the valves are listed by function rather than by series. 11

MOTOR SELECTION—Century Electric Co., St. Louis, Mo. 12-page, 1958 motor application guide, presenting information designed to facilitate motor selection. An application chart provides information on typical driven equipment, character of loads, starting and running torques. It also gives full details on the company's complete line of polyphase, single-phase, and direct-current motors of 1/20 to 400 hp. 12

MAGNETS—Indiana Steel Products Co., Valparaiso, Ind. Catalogue No. PR-19 describing stock permanent magnets, magnetizers, and demagnetizers. It lists over 70 Cast Alnico V magnets and over 30 Sintered Alnico II magnets available for immediate shipment in experimental quantities. 13

COUPLINGS—Link-Belt Co., Chicago, Ill. Folder 2875 detailing pertinent application and selection data for the new MC couplings, which are designed especially for use as motor couplings—for transmitting electric motor power to pumps, generators, speed reducers, etc. 14

VACUUM LIFTS—Union Tool Corporation, Warsaw, Ind. Illustrated brochure covering vacuum lifts for automatic production-line operations. It describes in detail the various standard and special Union vacuum lifts available. These include one- two- four- and six-station vacuum lifts, and combination vacuum lifts and stackers. 15

FLAME - HARDENED ROLLS — Detroit Flame Hardening Co., Detroit, Mich. Catalogue presenting engineering chart with ranges for hardness and depth usually required in rolls. Illustrations clearly demonstrate the sizes and kinds of rolls that are regularly flame-hardened, for such industries as steel, rubber, paper, glass, and food. 16

PLASTICS—Cadillac Plastic & Chemical Co., Detroit, Mich. 64-page catalogue of plastic sheets, rods, tubes, films, and lay-flat tubings. It lists available sizes, weights, color ranges, textures, purchasing specifications, grades, and prices. Also included is a 2-page comparison table of chemical, electrical, and mechanical properties. 17

CHEMICAL MILLING—Anadite, Inc.; South Gate, Calif. 30-page brochure describing chemical milling and metal finishing. This process is being used in aviation and missile industries. Also included is information on the Dow and HAE processes, and other important metal-finishing processes. 18

MILLING — Tri-Ordinate Corporation, Berkeley Heights, N. J. Brochure describing 3-dimensional milling and machining at production rates up to one part every eighteen seconds. It shows a typical two work-station machine, and development of space configurations through hydraulically actuated cams. 19

TOOL-HOLDERS—Sandvik Steel, Inc., Fair Lawn, N. J. 12-page booklet describing the Sandvik Coromant T-Max tool-holder and cataloguing the various styles available. Photographs and cross-sectional drawings clearly illustrate the automatically spring-lifted, triple-purpose chip-breaker which is the basic T-Max feature. 20

WORK DRIVER—Seneca Falls Machine Co., Seneca Falls, N. Y. 12-page bulletin

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D-57, describing the work driver for use on any type of engine lathe, multiple-tool lathe, or plain or universal grinder. It is designed to eliminate dogging time, increase productivity, and provide a high level of safety. 21

WELDING WIRE—American Chain & Cable Co., Inc., Bridgeport, Conn. 4-page folder DH-1218-M, replacing DH-1218-L, issued last year, detailing "as-welded" physical properties. Analysis, tensile strength, elongation, average Rockwell hardness indications, and lists of typical uses for gas welding rods, bare electrodes, automatic welding wire, and metal spray wire are included. 22

ADJUSTABLE-SPEED DRIVES — General Electric Co., Schenectady, N. Y. Bulletin GEA-5827A, explaining General Electric's Thymotrol drives— from 3/4 to 40 hp— and discussing a wide range of industrial applications for these drives. It is illustrated with photographs, cut-away and line drawings, as well as charts showing features and application data. 23

PRODUCTION CONTROL SYSTEM — Control Systems Co., a Division of Hancock Industries, Inc., Jackson, Mich. Brochure outlining a new production control system, "Telecontrol" which makes possible the extension of automation benefits to general manufacturing systems. 24

PLUG GAGES—K & K Grinding Co., Brooklyn, N. Y. Catalogue insert, giving specifications for more than 800 Go-NoGo gages. It presents, for the first time, K&K's complete line of plug-gage sets which feature made-to-order precision at production-line prices. 25

SPECIAL MACHINES—Grotnes Machine Works, Inc., Chicago, Ill. 8-page catalogue with photographs presenting representative Grotnes machines for expanding, shrinking, and roll-forming metal. Coilers, weld trimmers, seamers, and other equipment are also shown. 26

HYDRAULIC CYLINDER—Sheffer Corporation, Cincinnati, Ohio. Bulletin No. 658 describing C4H Series 1 1/8-inch bore hydraulic cylinder. It is of the square-head, all-steel interchangeable type, featuring fourteen standard mountings and four rod end styles. 27

METAL HOSE—Pennsylvania Flexible Metallic Tubing Co., Inc., Phila., Pa. 36-page brochure describing flexible Penflex metal hose, which is a 24-inch steel, interlocked tubing installed on diesel engine exhausts. It gives suggested specifications. 28

TUBE CUTTERS AND EXPANDERS—Gustav Wiedeke Co., Dayton, Ohio. Catalogue No. 81 describing tube expanders and cutters as well as accessories for these. It is profusely illustrated and gives complete specifications. 29

VIBRATING FEEDERS—Cleveland Vibrator Co., Cleveland, Ohio. Illustrated bulletin featuring air-operated vibrating feeders, available in lengths from 24 inches to 15 feet, which will closely control feeding rates. 30

FILTRATION UNITS—Industrial Filtration Co., Lebanon, Ind. 4-page bulletin describing operating principles, filtering efficiency, and applications of the Delpark Dual Manifold Filter-Matic Filter. Three types are illustrated. 31

THREAD-ROLLING HEADS—Landis Machine Co., Waynesboro, Pa. Bulletin F-99, on the Landis No. 5 stationary and revolving thread-rolling heads, including design and operating features. 32

MILLING UNITS—Colonial-Romulus Division, Colonial Broach & Machine Co., Detroit, Mich. 6-page bulletin CRD-58, giving specifications and features of basic building-block machines that can be mounted, fixtured, and operated in any plane. 33

TRACER CONTROL SYSTEMS—General Electric Co., Schenectady, N. Y. Bulletin GET-2736A providing functional description of General Electric's 2-dimension tracer control, featuring technical notes on operation, design, and experience of tracing performance. 34

COLLETS—Sutton Tool Co., Sturgis, Mich. Bulletin No. 20, describing diamond-grip collets for turret lathes. Featured are solid collets, master collets, and collet pads for Bardons & Oliver, Foster, Gisholt, Jones & Lamson, Warner & Swasey, and Oster machines. 35

MILLING MACHINES—Cincinnati Milling Machine Co., Cincinnati, Ohio. 45-page catalogue No. M-2003, presenting dial type milling machines. Illustrated are Nos. 2, 3, and 4 plain, universal, and vertical type milling machines for diversified operations. 36

WELDERS—Sciaky Bros., Inc., Chicago, Ill. 6-page Bulletin 317-2R, describing the Sciaky Type SP 2 spot-welder and Type EP 2 projection welder. These air-operated, press type, low-impedance,

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single-phase welders can be used for a wide range of high production fabricating applications. 37

COOLANT SEPARATORS—Sundstrand Machine Tool Co., Rockford, Ill. Brochure presenting a line of "Power-Grip" magnetic coolant separators consisting of four capacities of 25, 50, 75, and 100 gpm. These separators offer automatic coolant cleaning, and can be installed on numerous types of grinding, honing, and gear-shaving machines. 38

CUT-OFF WHEELS—Cincinnati Milling Products Division, Cincinnati Milling Machine Co., Cincinnati, Ohio. Booklet PG-336, describing cut-off wheels and the three bond types in which they are available—resinoid, rubber, and reinforced. Included also are a section devoted to cut-off practices and a table of suggested gradings for cut-off operations. 39

GRINDING MACHINE—Cincinnati Grinders, Inc., Cincinnati, Ohio. 21-page catalogue No. G-644-4 with photographs and detailed drawings presenting Cincinnati Filmatic No. 2 centerless grinders. . . 40

MILLING MACHINES—Sundstrand Machine Tool Co., Rockford, Ill. 19-page bulletin featuring three C-Model Rigidmils. It provides data and complete specifications. 41

STATIC CONTROL—Control, a division of Magnetics, Inc., Butler, Pa. 16-page catalogue featuring the company's completely new line of standard switching reactors for one-step, low-cost static control. 42

AUTOMATIC MACHINES—W. K. Millholland Machinery Co., Indianapolis, Ind. Illustrated circular featuring drilling, boring, milling, and tapping machines that can be built with Millholland's standard units. 43

CYLINDRICAL GRINDERS—Landis Tool Co., Waynesboro, Pa. Catalogue B-57, illustrating 6-inch Type CH and 10-inch Type LCH plain grinders, with pressure lubrication, eye-level wheel feed, and other new features. 44

PRESS EQUIPMENT—Cooper Weymouth, Inc., Stratford, Conn. Catalogue 58, containing features and specifications of a full line of reeling, straightening, feeding, and scrap-handling equipment for power presses, power shears, etc. 45

METAL PUNCHES—Whitney Metal Tool Co., Rockford, Ill. Two folders covering Whitney Nos. 16 and 17 bench hand metal punches. Dimensions, prices, and accessory equipment (including irregular-shaped punches and dies) are given. . . 46

HOISTS—Thor Power Tool Co., Chicago, Ill. 4-page manual featuring illustrations and descriptions of Thor H-1000 air hoists. It includes tables on rate of ascent and descent under various load conditions and air pressures. 47

AUTOMATIC LATHES—Seneca Falls Machine Co., Seneca Falls, N. Y. Bulletin Q-57, describing the Model Q double-way tracer type automatic lathes. These lathes are designed to combine rough- and finish-turning operations on a single machine. 48

PILOT VALVES—Logansport Machine Co., Inc., Logansport, Ind. Brochure presenting a line of 3-way pneumatic pilot valves. These are available with three mounting styles and types of operators. 49

AIR TOOLS—Pratt & Whitney Co., Inc., West Hartford, Conn. Circular describing high-speed air tools, additions to the Kellerflex line for burring, sanding, grinding, and polishing. 50

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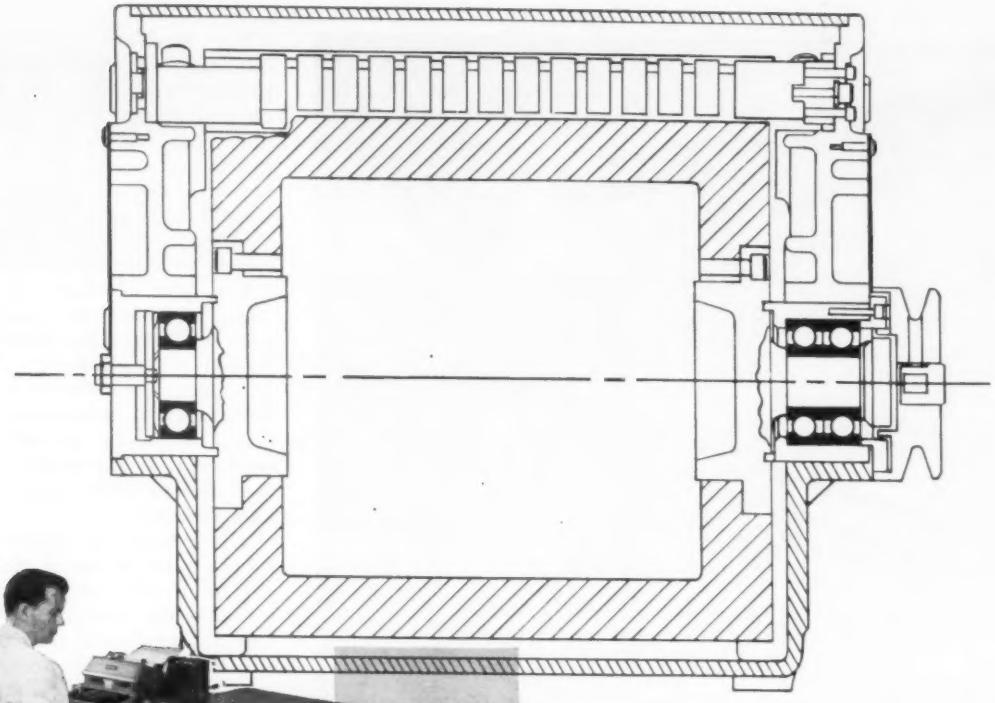

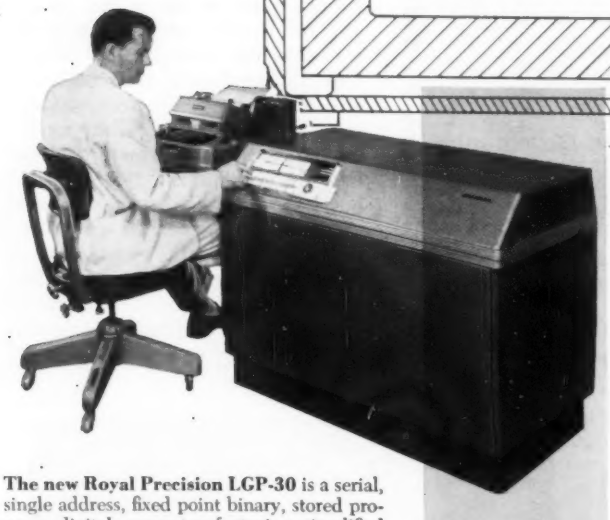

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Precise performance assured in Librascope's Fafnir-equipped LGP-30

Small as a desk, but it "thinks big"! No less than 4096 words can be recorded on the magnetic memory drum of the new Royal Precision Electronic Computer LGP-30. Moreover, this compact unit, made by Librascope, Inc., a subsidiary of General Precision Equipment Corporation, can be rolled where it's needed and plugged into any conventional wall outlet.

At the heart of this versatile computer, Fafnir super-precision type ball bearings maintain the precise alignment and high sensitivity required of the drum component. Counterbored to take a wide range of thrust, and radial loadings, these bearings provide the rigidity, extremely close-running accuracy, and low torque essential in this exacting application.

Fafnir's contribution to the development of the LGP-30 is another case history example of the high caliber and comprehensive scope of Fafnir design engineering services available to *you*. Take advantage of it when you have a bearing problem. The Fafnir Bearing Company, New Britain, Conn.

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Fafnir Super-Precision Type Ball Bearings are used in duplex pairs, mounted back-to-back, at the pulley end of the LGP-30 memory drum, and singly at the opposite end. These preloaded, angular-contact bearings, equipped with composition or bronze retainers, are widely used in precision-built mechanisms.

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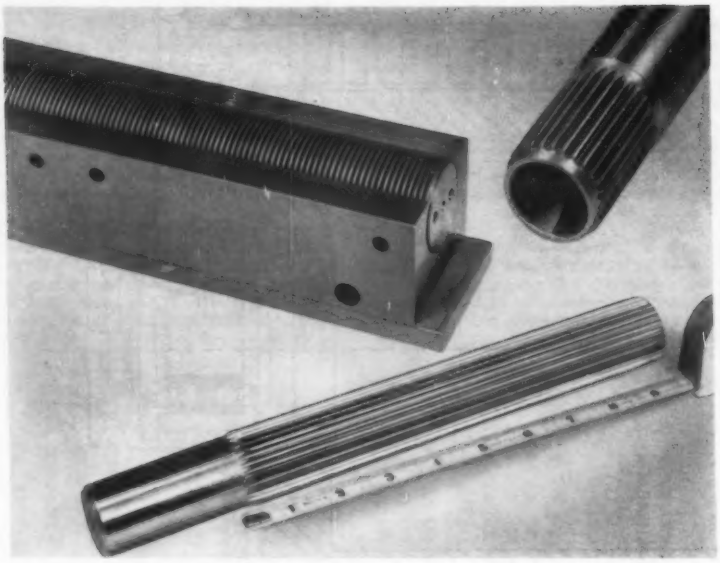


Fig. 1. (Upper right) Tubing with splines formed in Michigan Tool Co.'s Roto-Flo cold-rolling machine. (Lower right) Forming rack used in rolling splines. (Upper left) Forming rack and holder

Michigan Tool Introduces New Equipment Developments

Five developments in equipment for the metalworking industry were introduced by the Michigan Tool Co., Detroit, Mich., at a recent press showing. These units include two machine tools for use in producing gears, an adaptation of the company's fast spline rolling process to tube splining, a cost-saving method of restoring worn cutting tools, and a high-precision indexing attachment. A new variable-speed drive was also displayed.

The newly developed tooling for the company's Roto-Flo cold-rolling machines makes possible simple, quick, and inexpensive production of splines or serrations on tubing such as shown in the upper right corner of Fig. 1. Reciprocation of a cylindrical forming rack such as shown in the lower view is combined with an axial feed of the blank to cold-roll splines of any reasonable length. Splines and serrations up to 12 inches long are now being cold-rolled by this process. Thin-walled tubular parts having as little as 0.075 inch from the root of the tooth to the inside diameter of the tube can now be splined or serrated on Roto-Flo machines, since the required rolling pressures are relatively low.

The setup for spline rolling of tubular parts works in the same general manner as for Roto-Flo spline rolling of solid shafts. However, the new racks are considerably different—they are round, with all forming teeth of the same size. The racks are reciprocated over the part in a relatively short, but fast travel under an applied pressure of only 3000 to 4000 pounds. These racks generate exactly the same tooth form as would be produced by hobbing action. As the reciprocating racks follow a straight path, the part is

Fig. 2. Gear-finishing machine announced by the Michigan Tool Co.

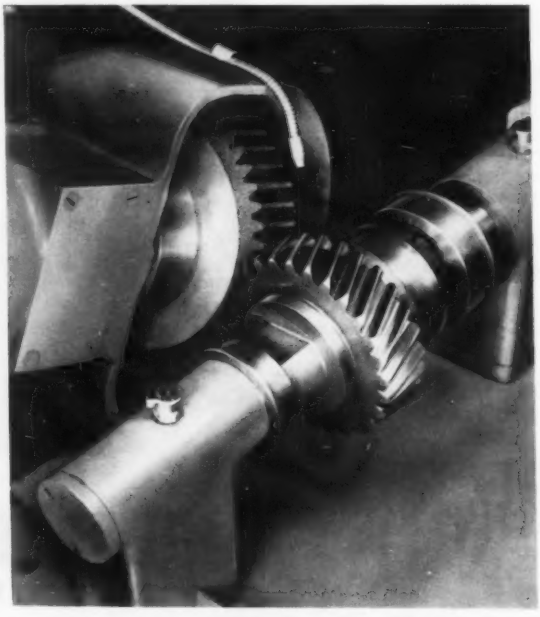


Fig. 3. Close-up of abrasive-impregnated gear-like tool and work

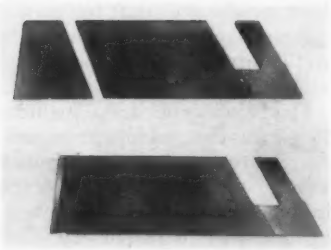


Fig. 4. Cutting tools for Shear-Speed gear-shaping machine

axially fed a predetermined distance until the desired spline length is obtained. The axial feed rate of the part is from 1/16 to 1/8 inch per second, depending on part diameter, pitch, and desired finish. The method permits the rolling of splines on undercut parts. For parts having shoulders, the rack can be notched, so that full-depth teeth may be formed to within 1/4 inch of the shoulder. A mandrel type headstock center is used when rolling thin-walled tubes to avoid any possible distortion of the inside of the tube.

The round forming racks are precision-made of high-alloy steel. As wear occurs, the round rack is rotated (indexed) in the holder to bring an unworn portion of the forming teeth into use. A typical forming rack and holder are shown in the upper left corner of Fig. 1. Indexing permits several settings for each rack, which cannot be re-ground. Their simplicity and high-use factor, however, make tool costs per part quite low.

Hardened small and medium-sized gears up to 12 inches in diameter can be economically finished to quiet-operating smoothness with abrasive throw-away tools on the Model 999 gear finishing machine shown in Fig. 2. In addition to finishing of regular gears, this machine also permits salvaging of noisy ones. The throw-away tooling employed in this equipment utilizes the crossed-axis finishing principle to quickly and effectively "clean up" hardened spur and helical gear teeth to improve their finish and sound characteristics. The average operating cycle time is little more than a minute.

The relatively low-cost abrasive-impregnated gear-like tool is rotated in tight mesh with, and drives, the hardened work gear in a crossed-axes relationship (about 25 degrees) as shown in the close-up, Fig. 3. Reciprocation of the work-table traverses the work gear across the tool for the full face width of the gear. The work gear is run in both directions during the process. A constant, predetermined pressure is maintained between the abrasive tool and the work gear to produce a tight-mesh finishing action. This permits the tool to finish the contour of the work gear even though the latter has a moderate amount of crown. A crowning attachment for finishing hard gears having especially high crowns is available.

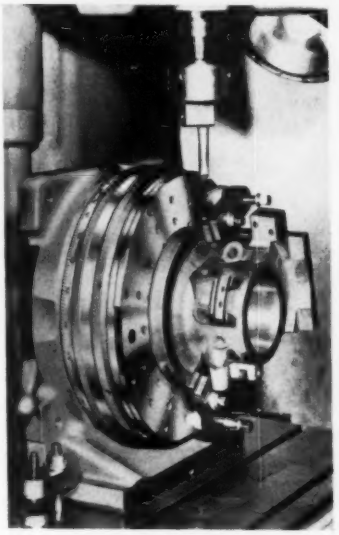


Fig. 5. Indexing head developed by AA Gage Co.

The finishing tool is a rotary abrasive-impregnated type. It is a precision tool of plastic abrasive (80 grit average) construction varying to suit the application. The inexpensive throw-away tool is supplied in a 9 1/4-inch diameter size in face widths of 1 inch and 1 1/2 inches.

This finishing method is adaptable to manual, semi-automatic, or fully automatic loading. The rotating speed of the tools is variable to suit size of gear being finished. Specially developed fluid, "Shear-Speed No. 50," supplied from a separate tank, is used both as a coolant and to flush away abraded material and grit.

Another development announced by the Michigan Tool Co. is a tool restoration service. Cutting tools such as shown in Fig. 4 for Shear-Speed type gear-shaping machines can now be reused at considerable savings over original tool cost. The operation consists of induction-brazing new tips to the shank of the worn blades. Blades retipped and reworked to original dimensional specifications can be supplied for all Shear-Speed gear shapers now in use.

The Michigan Tool Co. has announced that it will act as the ex-

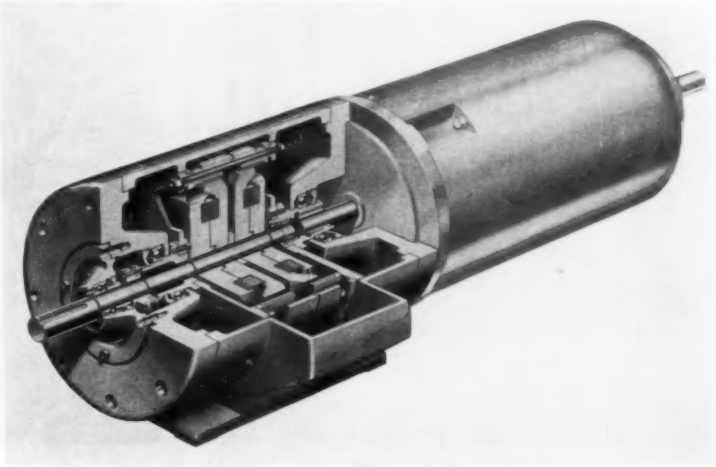


Fig. 6. Marvex variable-speed drive developed by Cone-Drive Gears

clusive sales outlet for an indexing head, Fig. 5, developed by the AA Gage Co., Detroit, Mich. When checked out on an interferometer in Michigan's research and development laboratory, the indexing head was found highly accurate, doing for arc measurement what the gage-block now does for linear measuring. It obtains fractional accuracies through a concept that consists of hundreds of angular-plane mating surfaces, making contact at each one of the 360-degree settings with an equal number of the meticulously accurate mating surfaces. Thus, each time the head is indexed, accuracy is assured, not by one or two mating surfaces, but by hundreds. The head is said to become more accurate with use. The so-called "wear" due to the metal-to-metal contact of the serrations inside the head actually produces a closer tolerance finish on each of the tooth faces. How much more accuracy this "wear" provides is not known yet, but it can definitely be detected in the dividing-head models which have been in use the past two years.

The Marvex stepless variable-speed drive, Fig. 6, under development for several years by Cone-Drive Gears, Division of Michigan Tool Co., has just been introduced to the trade. Four drip-proof models in six different sizes are available. Models include: a separate controlled-slip coupling and various combinations to serve as (a) variable-speed gear-motor, (b) variable-speed motor, and (c) special unit for integral mounting of speed reducers. They will handle motors up to 150 hp at 1750 rpm. Maximum torque transmittal is 450 foot-pounds. Direct-current power supplies are not required. The drive can be stalled at full torque without overheating when driven by 1750-rpm motors of any power rating up to 100 hp.

Fields of application include: drives for fans, pumps, compressors, extrusion machines, punch presses, cranes, winches, tube draw benches, rolling mills, winding and reeling machinery, conveyors, printing machinery, centrifugal casting machines, and machines requiring rapid and frequent reversal.

Circle Item 125 on postcard, page 179

Taft-Peirce Semi-Automatic Lapping Machine

A 24-inch semi-automatic lapping machine has been developed by the Taft-Peirce Mfg. Co., Woonsocket, R. I., which can produce surfaces that are flat within an accuracy limit of one light band (0.00011 inch). It will also give a surface finish of 1 microinch. The work cycle is fully automatic, including the application of the lapping compound and operation of a variable-speed drive for selecting the best lapping rate. Specially designed magnetic truing rings maintain continuous plate flatness.

This machine, Fig. 1, is designed primarily for lapping small parts in production lots. It can also accommodate any large casting such as shown in the lapping position in Fig. 2, or similar part that will fit in any one of the truing rings, which have an inside diameter of 8 7/8 inches. Small parts are placed inside the truing rings using masonite separators, where they are held in contact for lapping by weight plates. These masonite separator plates can be cut, drilled or otherwise shaped to accommodate parts of any outline. The final critical measure of ac-

(Continued on page 190)

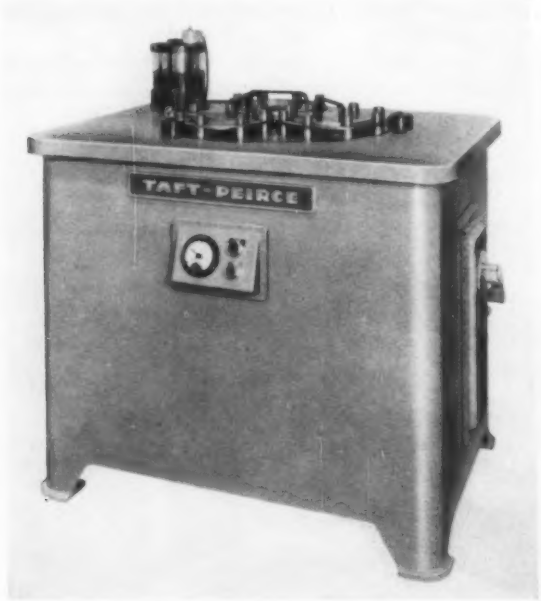
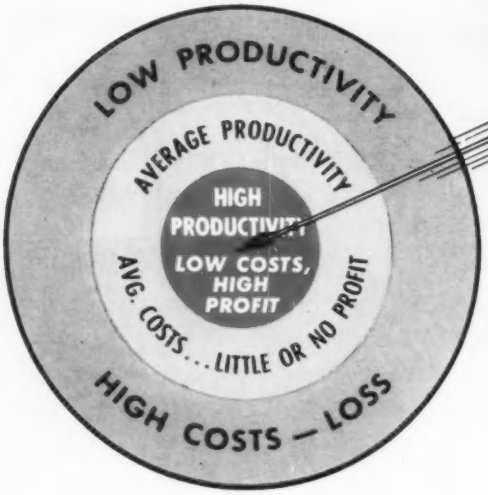


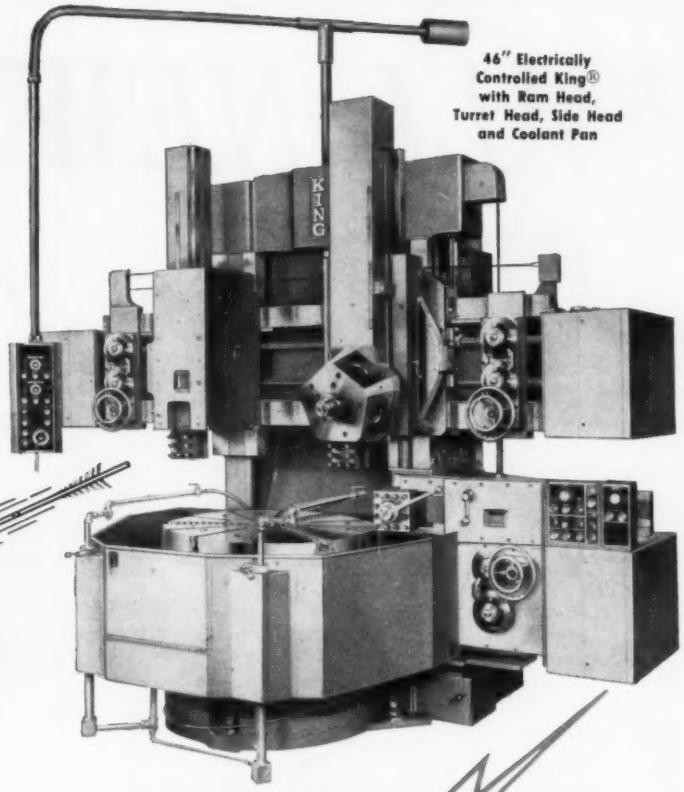
Fig. 1. Semi-automatic lapping machine developed by the Taft-Peirce Mfg. Co.

Fig. 2. Lapping leakproof joint on pump casting with machine shown in Fig. 1

IF YOU DON'T HIT THE "BULL'S EYE"

...You Can't Win the Game!





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- **AUTOMATIC LUBRICATION of all moving parts.**
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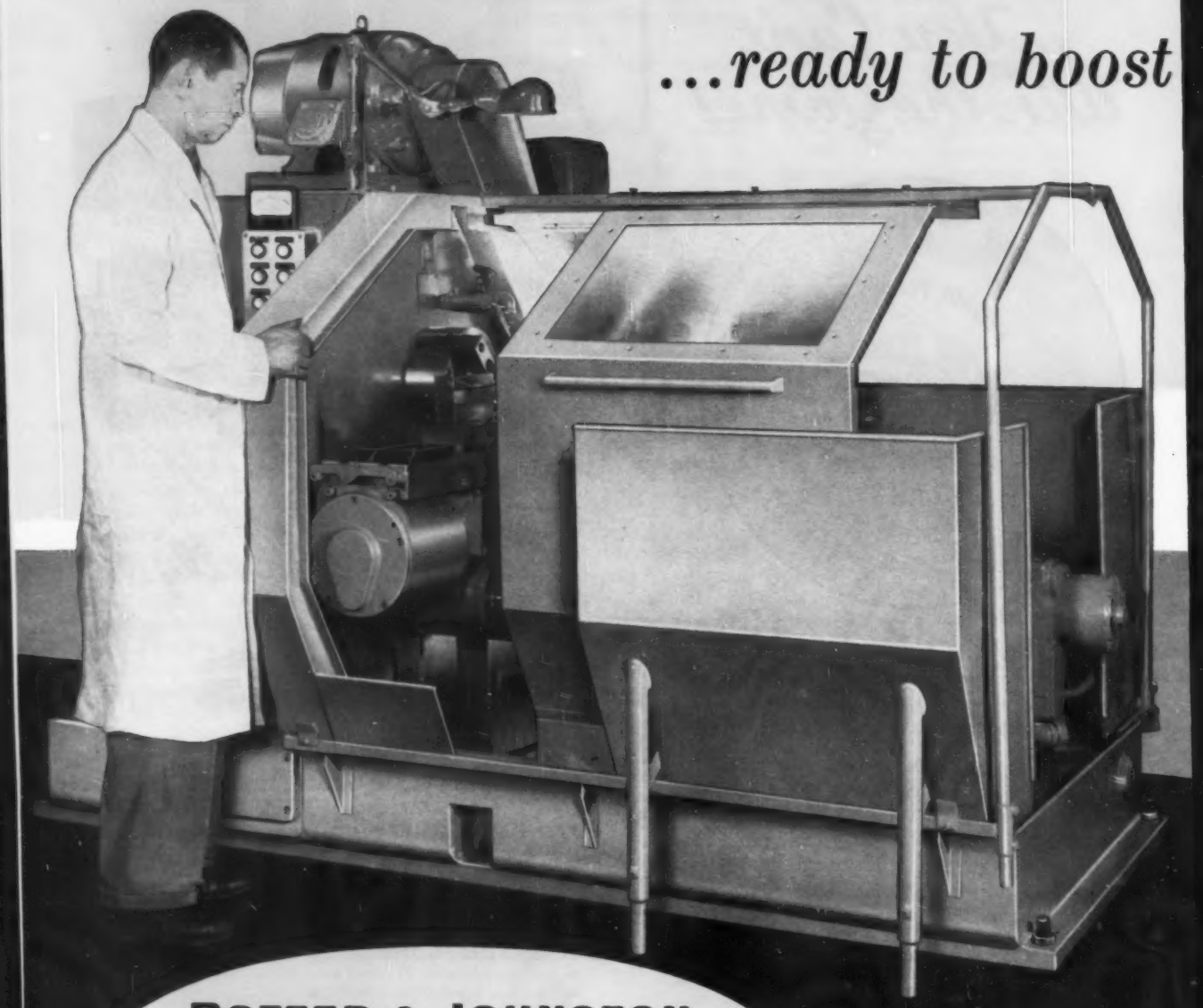
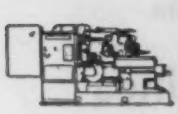
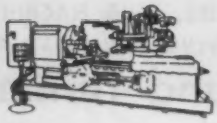


POTTER & JOHNSTON

3E-15



AUTOMATIC
TURRET LATHES



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Turret Lathe

YOUR production!

To help you produce parts faster and at lower cost, the Potter & Johnston 3E-15 Automatic Turret Lathe offers every advanced feature you've been looking for. It's completely new in design and construction. This machine gives you the power and extra rigidity you need to hog out tough alloys faster . . . plus the precision you want to hold closer tolerances and produce smooth finishes. Set-up is fast and easy, saving valuable time and insuring lowest per-part costs on both short and long runs. Real tooling versatility will help you machine the most complicated cuts with new speed and efficiency. The 10-inch chuck capacity combined with wide speed and feed ranges will let you handle a very broad variety of work types and sizes.

HERE'S EVERYTHING YOU NEED TO HANDLE YOUR JOBS FASTER, BETTER, MORE PROFITABLY —

FASTER METAL REMOVAL

- **INCREASED POWER . . .** with all-new 15 hp headstock for fast accurate removal of the toughest alloys.
- **GREATER RIGIDITY THROUGHOUT . . .** with new, heavy steel weldment base and hardened-and-ground tool steel ways.
- **TURRET COOLANT SYSTEM . . .** in addition to overhead system. Lets you pump coolant through turret tools for maximum efficiency in drilling, boring and other internal machining operations.

FASTER SET-UP

- **NEW CROSS SLIDE CONTROL . . .** with selector switches now provides faster, easier set-up for delayed or on-time movement. Cross slides can be operated together or independently with any turret face and can be adjusted longitudinally, independent of each other.
- **NEW INDEPENDENT MOTOR DRIVE FOR TURRET INDEXING . . .** permits indexing during set-up without forward travel of the turret.
- **EXTRA-LARGE CONTROL DRUM . . .** located for easy access, insures fast programming of all machine functions including automatic speed and feed changes, rapid traverse, etc.
- **6-FACE TURRET . . .** allows opportunities for greater tooling flexibility.

REDUCED MAINTENANCE

- **ELECTRIC CLUTCHES THROUGHOUT . . .** are self-compensating for wear, require no adjustment.
- **CENTRALIZED AUTOMATIC LUBRICATION . . .** for turret slide, cross slide and base, reduces wear and insures smooth operation of all moving parts.

SEND NOW FOR THE FACTS . . . *mail this coupon today for your free copy of Bulletin No. 172. Contains complete data and specifications on the new Potter & Johnston 3E-15 Automatic. If you prefer, ask a P&J Representative to call and discuss its advantages with you. There is no obligation, of course.*

POTTER & JOHNSTON COMPANY
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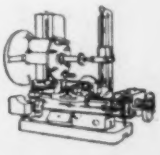
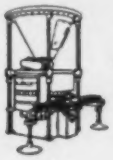


GEAR CUTTERS



PACKAGING MACHINES

curacy in generating true contact surfaces on a selectable-cycle production basis is exemplified in Fig. 2. The pump casting seen in this illustration is having its flange lapped to produce a leakproof joint that requires no gaskets or joint cement. The casting being lapped rests firmly against the plate under its own weight. Flatness is held within one light band, and surface finish to one microinch.

Practically any type of material can be successfully lapped on this machine, including the toughest alloys in their hardened state, and non-ferrous metals, such as brass, bronze, and aluminum. Even nonmetals such as plastic and ceramics can be successfully finished. Parts assembled from a number of different materials can also be processed. In each instance, selection of the proper lapping compound and plate speed is all that is required to produce the required surface finish.

Operation of the lapper is extremely simple, a complete battery of the machines being easily handled by one operator. The lapping-table speed is infinitely variable between 16 and 76 rpm. The lapping compound is automatically supplied from a special tank which has a built-in agitator.

Circle Item 126 on postcard, page 179

Cleveland 150-Ton Press

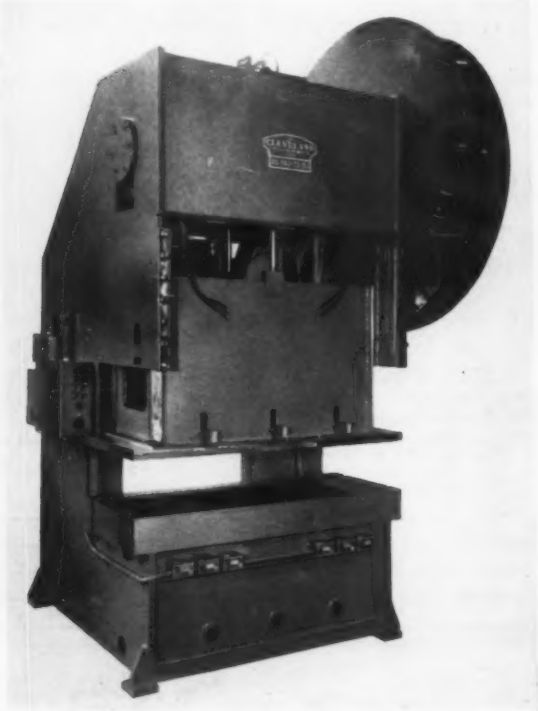
A double-crank open-back gap press designed for automatic feeds and greater convenience in handling large or irregular sheets has been announced by the Cleveland Punch & Shear Works Co., Cleveland, Ohio. This 150-ton press is of welded steel construction and is equipped with an electrically controlled drum type friction clutch. Except for its cutback housings, this single-geared press embodies all the essential features of the manufacturer's standard straight-sided double-crank presses. Its slide is provided with power adjustment, is air-counter-balanced, has a stroke of 10 inches and an adjustment of 5 inches. The shut height is 22 inches. Both bed and slide have a tool- or die-mounting area of 28 by 72 inches.

The press is built for safe, efficient operation, having all gears and the drive mechanism completely enclosed and an auxiliary air brake on the flywheel to insure quick stopping. The basic design is extremely flexible, permitting the various dimensions such as stroke, slide adjustment, bed and slide areas to be modified to suit specific requirements. Cleveland presses of this type are available in an almost unlimited range of sizes for punching, shearing, perforating, bending, and forming of metal of almost any thickness from light sheet to heavy plate.

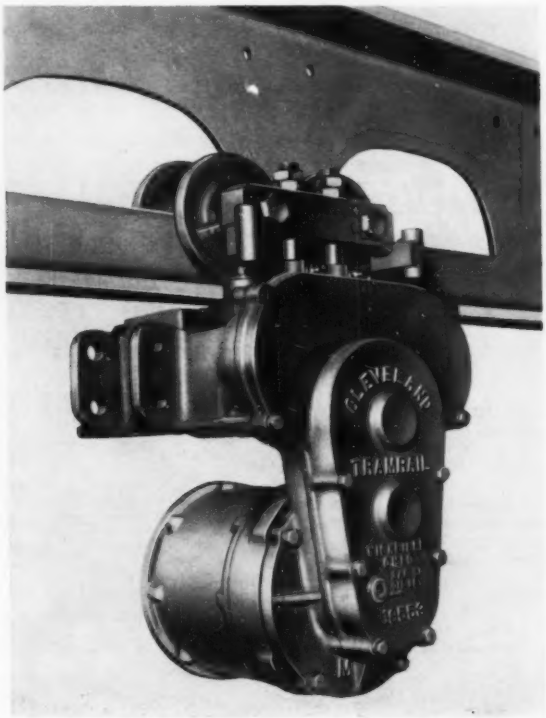
Circle Item 127 on postcard, page 179

Overhead Tramrail Tractor

A motor-powered tractor for use on overhead tramrail materials-handling systems has been developed by the Cleveland Tramrail Division of The Cleveland



Cleveland 150-ton double-crank open-back gap press designed for use with automatic feeds



Overhead tramrail tractor announced by Cleveland Crane & Engineering Co.

Segmented automation makes conversion practical

Talk to

Snyder

TOOL AND ENGINEERING COMPANY

3400 E. Lafayette, Detroit 7, Michigan

Special Machine Tools with Automation for More Than 30 Years

Crane & Engineering Co., Wickliffe, Ohio. This Type 'MT' tractor is driven by two 5-inch diameter steel rollers held under spring pressure against the bottom of the track. Rubber drive-rollers are also available for special applications. The tractor will develop a draw-bar pull of 300 pounds. It can be used as a single-motor drive for one or more carriers in a train and for motorization of hand-power cranes and carriers. It is especially adaptable for systems having inclined tracks.

Minimum speeds of this unit are: 50 feet per minute with a 1/2-hp motor, 75 feet per minute with a 3/4-hp motor, and 100 feet per minute with 1-, 1 1/2-, or 2-hp motors. The maximum speed is 350 feet per minute.

The 'MT' tractor is recommended for floor-controlled carriers or cranes and automatic dispatch units. It can be used on platform or cab-operated carriers or cranes subjected to average service.

Circle Item 128 on postcard, page 179

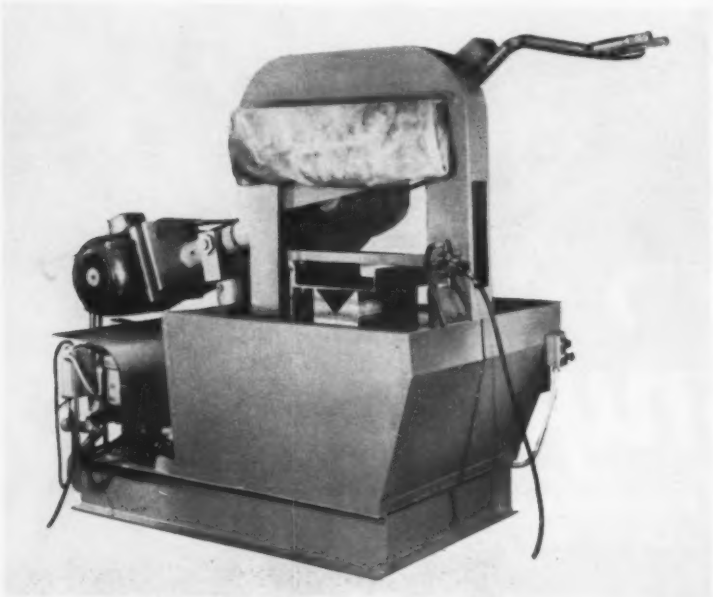
"See-Saw" Wet or Dry Abrasive Cutting Unit

A cut-off machine called the "See-Saw," which enables the user to guide the abrasive wheel along the most effective path or contour for cutting such sections as channel iron, has been developed by the Wallace Supplies Mfg. Co., Chicago, Ill. This machine has a cutting area 9 by 18 inches. It employs rubber-bonded wheels for wet cutting and resinoid-bonded wheels for dry cutting. Either square or miter cuts can be taken. Plate material 3 by 18 inches, 18-inch channel iron, 8-inch round or square bars, or any comparable sections can be cut.

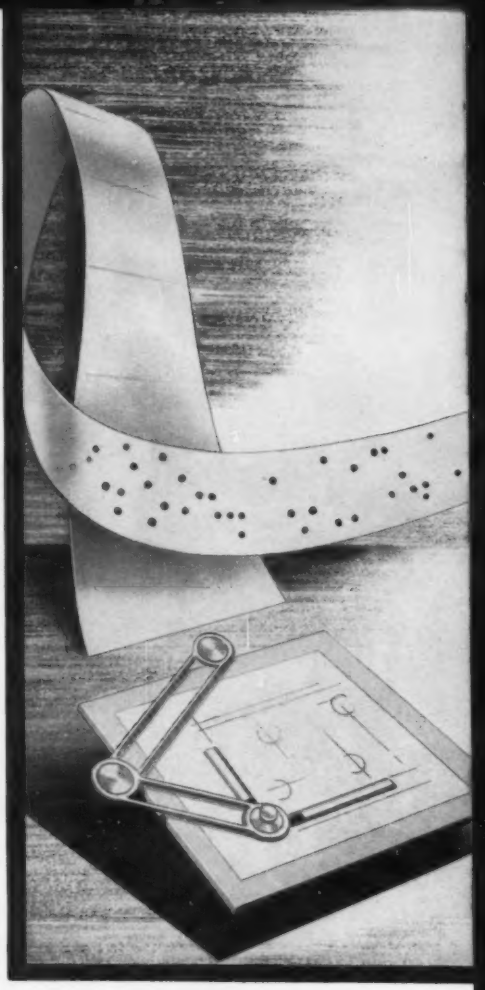
The machine is powered by three separate motors. One rotates the cutting wheel and is always functioning during a cut. A second drives the forward-and-back travel of the cutting head. Handling of this motor is the function of a push-button control on the right operating handle. A third motor unit supplies more than 35 gallons of cutting compound to the cutting area. This is controlled by a push-button on the left handle. The downward cutting pressure is directed by the two hands of the operator, who grasps the two operating handles which may be seen near the upper right corner of the illustration.

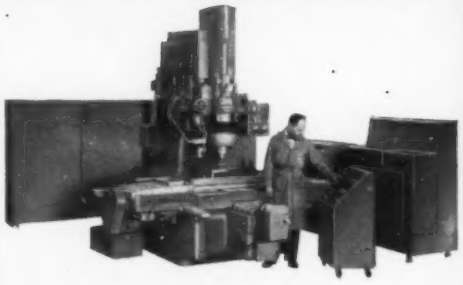
Circle Item 129 on postcard, page 179

(This section continued on page 194)



Abrasive cut-off machine developed by the Wallace Supplies Mfg. Co.





OTHER P&W NUMERICALLY CONTROLLED MACHINE TOOLS

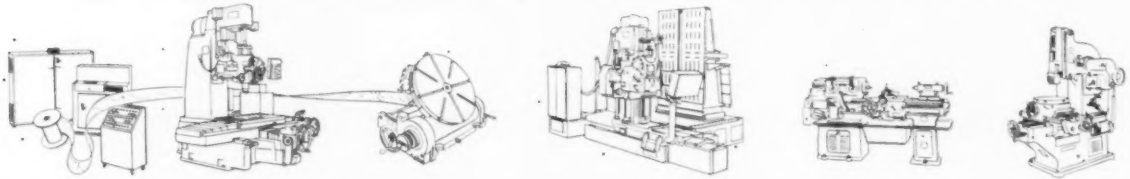
. . . include the No. 2E Vertical Precision Hole Grinder and the 42" Precision Rotary Table.

PRECISION JIG BORING TIME CUT 90% . . .

. . . **WITH P&W NUMERICAL CONTROL!** Precision work put on *predictable* production schedules, completed in as little as 1/10 the time required by previous methods. Costly human errors are eliminated. Positioning accurate to "tenths" absolutely guaranteed. These benefits are reported by Dexter Tool Company of Hazel Park, Michigan, since installing a Pratt & Whitney Numerically Controlled Jig Borer. Dexter produces precision aircraft and automotive components. Work involves 6 to 50 identically machined parts, and it's important to guarantee precision, accurately estimate production time and deliver on schedule. Positioning itself automatically by punched tape, the Numerically Controlled Jig Borer handles "tenths" limits as fast and surely as ordinary work. A Dexter spokesman states, "We think the P&W 2E Numerical is the greatest single improvement in machine tooling. It's the ultimate."

Today, "tenths" limits are common, yet profitable operation demands that you produce faster than ever before. Pratt & Whitney Machine Tools with Numerical Control can provide the right answer for you!

Write now for complete information.
Pratt & Whitney Company, Inc.
12 Charter Oak Boulevard, West Hartford, Conn.



NUMERICAL CONTROL . . . JIG BORERS . . . ROTARY TABLES . . . KELLER MACHINES . . . LATHES . . . VERTICAL SHAPERS

PRATT & WHITNEY

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MACHINE TOOLS • GAGES • CUTTING TOOLS

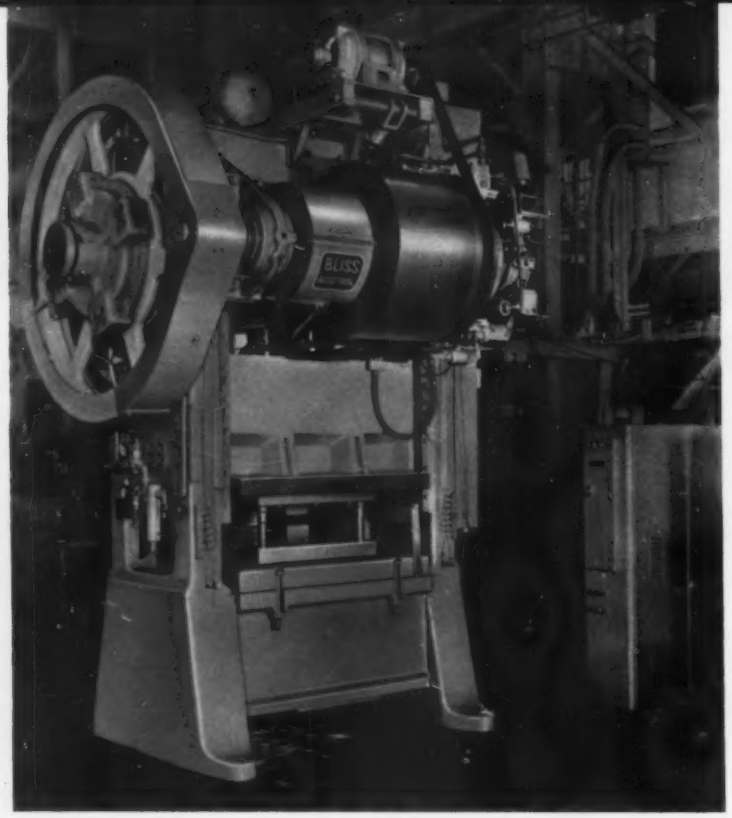


Fig. 1. Bliss press equipped with electronic driving unit

Bliss Electronic Drive for Press and Die-Handling Machine

An electronic drive for presses, known as the "Accutrol," that permits reverse jogging without stopping and reversing the motor, has been developed by the E. W. Bliss Co., Canton, Ohio. With this drive, it is possible to raise or back away the press ram instantly, and thus save considerable time when setting large dies. Also, bottoming dies may be brought together with an easy, reverse jog and pulled out sharply by a normal jog. The jogging torques and speeds are adjustable.

Presses equipped with the "Accutrol" drive, as shown in Fig. 1, can be operated with the new combinations of approaching, working, and return speeds to meet changing production requirements. For example, it permits a rapid advance to the work, compensated automatic slowdown to prevent tearing of the blanks, and a fast return stroke. A slight twist of a dial provides the compensation necessary for a difficult job or a load of poor material.

The device is electronic in both power and control. It delivers, alternately, direct and alternating current to induction windings. Power is supplied through mercury-pool ignitrons. The servo system, which co-ordinates analog and digital signals, is highly versatile in selectivity. This new use of direct and alternating currents under precise electronic control provides a fast and responsive method of putting in and taking out large amounts of energy.

The die-handling machine shown in Fig. 2, designed to safely and quickly manipulate dies in press room or die shop, is another new development of the E. W. Bliss Co. This equipment can be used either to turn over or open a die set, without danger of damaging the dies. The wheel-mounted platens, both with JIC T-slots, are raised and rolled over by a power-operated screw.

To open a die, the top platen is raised and turned over to simulate a press slide. A die set is placed on the other platen and shuttled into position under the top platen. The top platen is then lowered to the die and the top shoe bolted to it. This shoe is then lifted from the bottom shoe and rolled over. To complete the die-opening procedure, the bottom shoe is shuttled out, and the top platen and shoe are returned to the rails and shuttled out. To turn a die set over, the above procedure is followed, then repeated in reverse order, with the bottom shoe raised, turned, and lowered on the top shoe. Open-top contruction of the die-handling machine permits removal of a half die by crane at any point in the operation.

Circle Item 130 on postcard, page 179

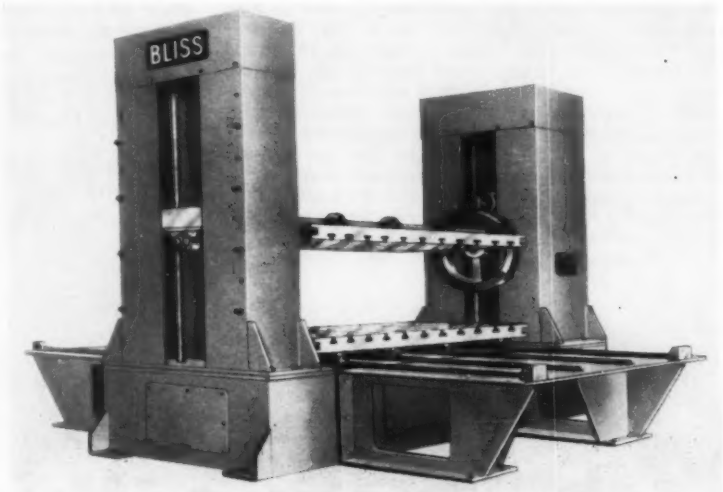


Fig. 2. Die-handling machine developed by the E. W. Bliss Co.

Compact Vidmar cabinets permit a variety of items to be stored in a minimum amount of space

Vidmar Storage Cabinets

Vidmar, Inc., a division of Volkert Stampings, Inc., Queens Village, N. Y., announces a line of engineered metal storage cabinets of modular design. Currently, Vidmar is erecting a new plant in Williamsport, Pa., to start volume production on the line in early summer. The cabinets store parts and equipment so as to make every item immediately available, and at the same time provide complete visual inventory control. By a simple locking device, all drawers in a bank of cabinets can be locked with the turn of a single handle.

All cabinets measure 30 inches wide by 27 3/4 inches deep, and are available in six heights, from 27 inches to 10 feet. Drawers, 25 inches square, are made in twelve heights, from 1 1/2 to 13 1/4 inches. Dividers can be located in slots in the drawers in either direction, providing any desired interior arrangement. Aluminum trays hold parts like small twist drills and end-mills. A label holder snaps over the divider at any position to identify contents. Frames and drawers are constructed of heavy sheet to withstand rugged use.

Drawers ride on ball-bearing slides, and can be pulled out to their entire depth to completely expose contents. Each drawer supports a maximum weight of 400 pounds, and can be lifted out and moved by crane to any part of the shop. Drawer pulls are full width, and have slots to carry large, legible labels.

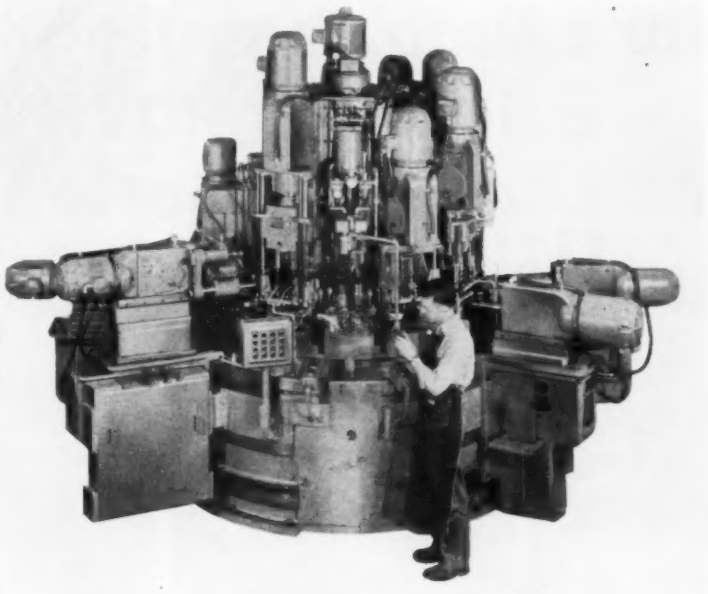
Circle Item 131 on postcard, page 179

Kingsbury Multiple-Unit Automatic for Processing Power Steering Housings

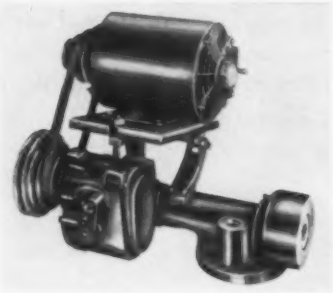
A multiple-unit automatic, built by the Kingsbury Machine Tool Corporation, Keene, N. H., has sixteen units with thirty-one spindles that drill, recess, mill, spotface, counterbore, chamfer, ream, and tap on four sides of power-steering housing castings at a gross production rate of 270 parts per hour. A 63-inch index-table holds twelve double-chucking work fixtures with power clamping and automatic unclamping.

Ten vertical units on the center column operate five tools in the first chucking, and twelve tools in the second chucking. The operations include rough- and finish-recessing of two grooves, holding the specified distance between them within limits of plus or minus 0.0015 inch. Six horizontal units mounted on knees of the machine serve to operate seven tools in each chucking. Nine of the units are provided with multiple-spindle auxiliary heads. Bushings are incorporated in the equipment which accurately guide twenty-four of the thirty-one tools employed in processing the steering housings.

Circle Item 132 on postcard, page 179



Kingsbury multiple-unit automatic for processing power steering housing



Milling attachment introduced by Alva Allen Industries

Allen Milling Attachment

A Model M milling attachment which can be mounted on lathes, milling machines, turret lathes, planers, and boring mills, for performing work such as keyseating, milling, slotting, drilling, shaping, boring, splining, and squaring, has been introduced by the Alva Allen Industries, Clinton, Mo. This attachment can be employed for precision work on small or large parts. It requires very little space either in operation or storage.

The spindle is mounted on Timken taper roller bearings and has a No. 3 Morse taper for holding the tool. Six different speeds, ranging from 200 to 900 rpm, are available. Height from bottom of base to center line of spindle is 2 inches. Total weight, including 1/2-hp motor, is 63 pounds.

Circle Item 133 on postcard, page 179

High-Pressure Coolant System

A high-pressure coolant system that can be used with carbide-tipped gun drills has been introduced by the Edlund Machinery Co., Cortland, N. Y. This system, called the Model 2HPC, has an oil capacity of 140 gallons and is furnished with either a 5- or 10-hp motor. The smaller motor delivers 10 gallons per hour, and the larger one, 20 gallons per hour. Pressures are adjustable to 1000 psi. The oil returned from the drill is collected in a settling tank which has a removable strainer. From the tank, the oil is pumped by separate low-pressure pumps through two replaceable filters that filter as fine as 10 microns.

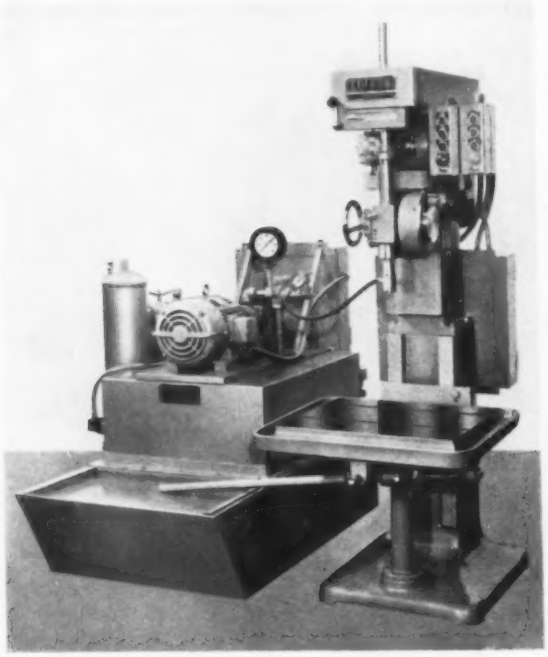
Oil temperature is thermostatically regulated through an adjustable temperature control, usually by a water cooling system. However, refrigeration can be used if required. Each oil reservoir tank has its own oil level gage; and there is an alarm system which indicates a low supply of oil. The coolant system is 70 inches long, 51 inches high, 44 inches wide, and weighs 1525 pounds. It can be used with the Edlund Model 2G gun-drilling machine and other drilling equipment.

Circle Item 134 on postcard, page 179

"Safe-Torque" Tap Driver

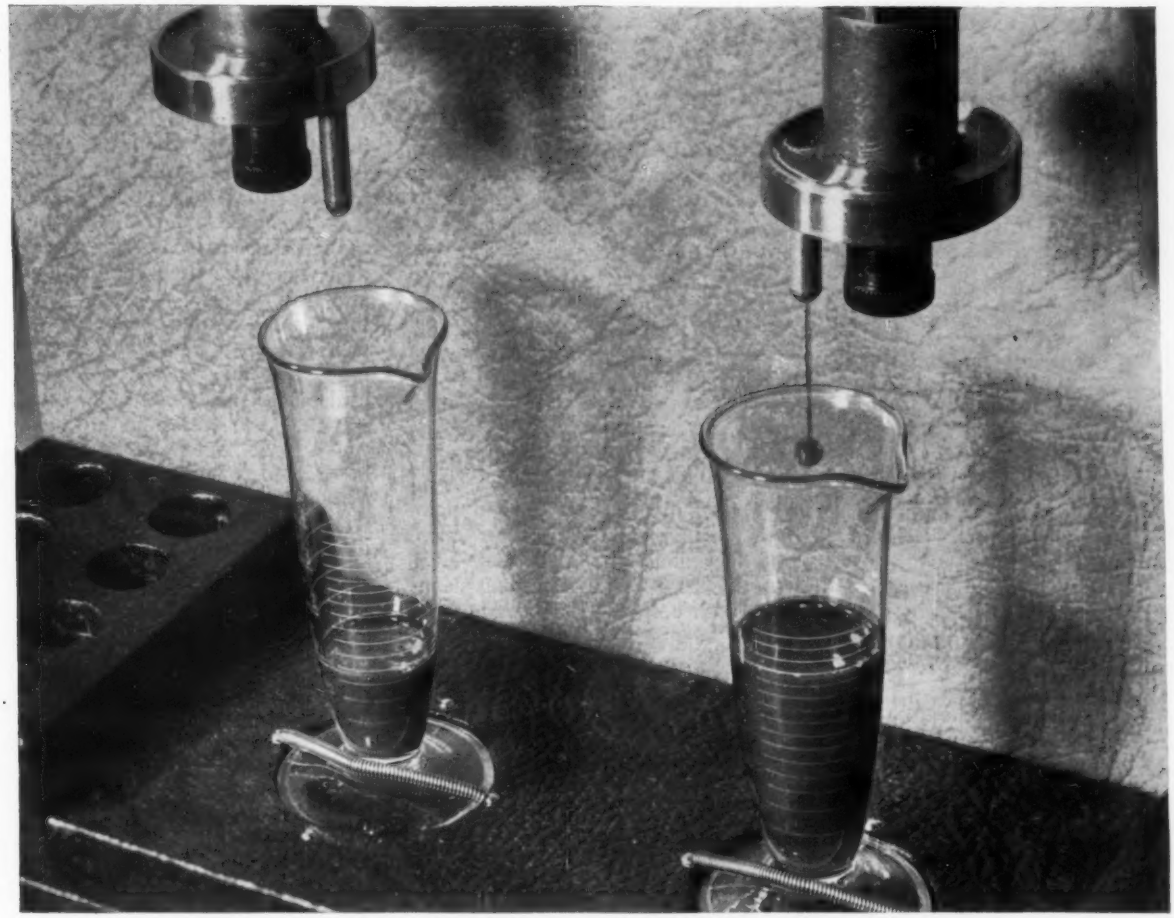
A reversible "Safe-Torque" tap driver designed to prevent tap breakage and increase tap life is announced by Scully-Jones & Co., Chicago, Ill. The tap driver is available either as a complete unit or as an assembly that includes only the driver, taper shank arbor, wrenches, and stop rod. The complete set includes, in addition, depth-stop assembly and a set of six tap chucks for machine screw tap sizes: Nos. 0-6, 10, 12, 14, and the 1/4-inch hand tap.

This reversible tap driver is made for tapping operations on machines which have no means for reversing the spindle. The gear type reversing mechanism automatically engages the driver spindle and reverses tap rotation when the machine spindle is raised, eliminating the need to



Edlund drilling machine and coolant system

Scully-Jones "Safe-Torque" tap driver



The oils collecting in these graduates are being forced, at 100 psi, through two sintered bronze bearings. Although each oil has the same viscosity, the Suntac on the left is leaking *only one quarter as much as* the straight oil on the right.

Desk-top demonstration proves that SUNTAC HYDRAULIC OILS can cut your oil losses . . . up to 75%

Suntac® oils are competitive in price, competitive in quality, *and unique in their ability to reduce oil leakage without costly shutdowns.*

Suntac oils are high-quality, exceptionally stable mineral oils especially compounded to reduce leakage. Experience proves that they give longer pump and seal life with higher overall operating efficiency.

See for yourself how a Suntac oil can cut your oil costs. A simple desk-top demonstration will show you how.

Ask your Sun man to show you how others have reduced oil consumption, or write to Dept. M-6.

Industrial Products Department

SUN OIL COMPANY, Phila. 3, Pa.

SUNOCO®

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For more information fill in page number on Inquiry Card, on page 179

stop the machine and reverse the spindle.

Torque settings, below the breaking strength of the tap, are made by rotating an adjusting ring on the driver to move the entire roller mechanism in or out of the tapered drive shell surrounding the rollers. This movement (in for higher torque, out for lower torque) changes the clearances between the rollers located between the driving shell and the cam-drive. Once engaged, the tap can follow its own lead because the tension spring in the driver spindle allows the tap to float.

Circle Item 135 on postcard, page 179

Multiple-Spindle Drilling Machine

A versatile multiple-spindle machine which performs drilling and tapping operations simultaneously at a production rate of 400 parts per hour is being built by the National Automatic Tool Co., Inc., Richmond, Ind. The unit is available with 16 or 24 spindles. Half of the spindles, located on one side of the head, are used for drilling, and are driven by a standard electric motor. Those on the other side are driven by a high-reversal duty hydraulic tapping motor. Although the machine illustrated is built to handle a specific job, it is easily adaptable to many other uses. It is equipped with a simple five-position, push-through fixture for drilling and tapping front frames of electric typewriters.

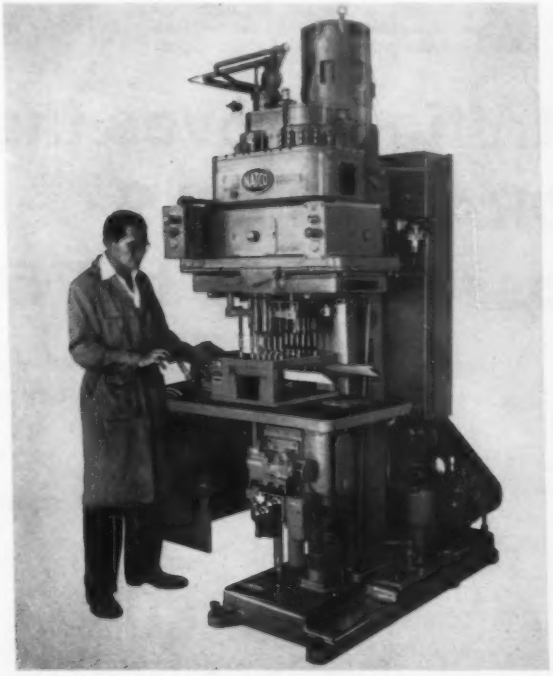
Loading is accomplished during machine operations, and unloading is automatic as parts drop down a chute. During processing, parts are located and held by spring-loaded locating pins. A rotating table can be used to maintain high production rates where operations are such that additional locating or clamping means are necessary. The machine can be adapted to general-purpose use by substituting adjustable arm spindles for the slip spindles.

In the machine illustrated, the table moves up and down hydraulically—rapid traverse up, feed up, feed down, and rapid traverse down. Two feed rates may be used, with automatic change if needed. The same spindles which are used for drilling also may be used for tapping by turning a knurled ring which provides a half-inch "float," making it possible to tap different leads at the same time. Individual spindles have both high and low speeds. Also, speeds can be varied by changing the main-drive speed by means of a two-speed shift and pick-off gear. A 3-hp drive motor is used on the 24-spindle machines, and a 5-hp motor on the 16-spindle heavy-duty model.

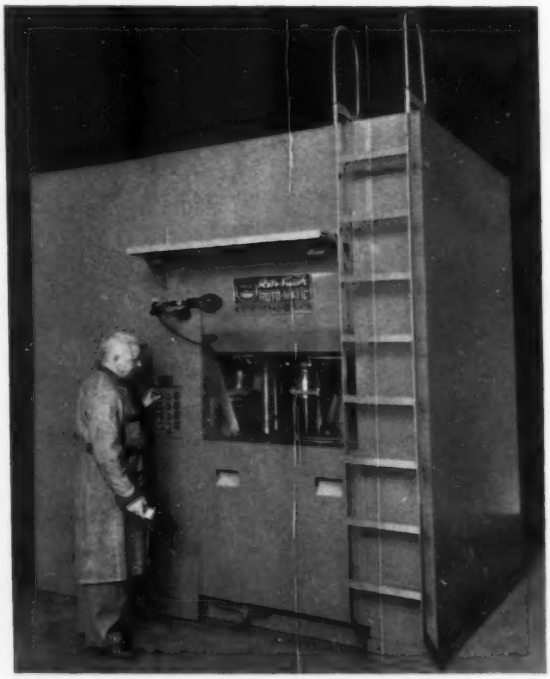
Circle Item 136 on postcard, page 179

"Roto-Matic" Mechanical Finishing Machine

A machine for mechanical finishing of metal components, called the "Roto-Matic," has been brought out by the Roto-Finish Co., Kalamazoo, Mich. This machine is now being used to finish parts as diverse in size and finish requirements as refrigeration compressor components, jet engine blades, and heavy-steel steering knuckles. It is used primarily as a deburring unit, but its range



Versatile multiple-spindle drilling machine built by National Automatic Tool Co.



"Roto-Matic" finishing machine brought out by the Roto-Finish Co.

all you've wanted in

PRODUCTION TYPE—SIZE CONTROL

HONING TOOLS

DESIGN AND OPERATING SIMPLICITY

A new rigid shaft construction, without "universal joints" makes the Jes-Cal size control hone a solidly supported extension of the machine spindle. This construction eliminates the need for actuating bushings and bushing bracket, permits generation of bore accuracy and correction of error within limits of only a few ten-thousandths of an inch, closer parallelism of bore axes as in cylinder blocks, and eliminates "swipes" as the tool leaves the bore. Simpler tool design with relatively fewer, precision built parts minimizes chatter, permitting faster, cooler, more positive cutting action with lower cutting pressure.

The Jes-Cal size control gage is positioned around the honing tool spindle. It has carbide tipped contact points for long, hard service of many months without losing size, and is the most positive, dependable and economical method of size control available. This gage stops honing action immediately and automatically, through a simple limit switch, when the gage enters the bore.

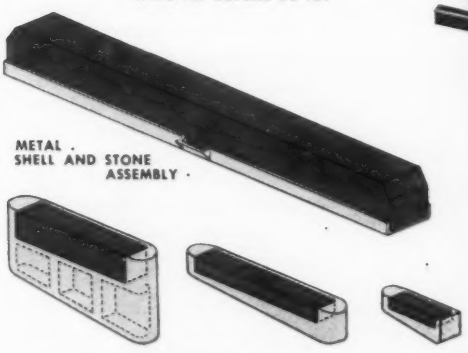
DEPENDABLE MACHINING ACTION

The Jes-Cal rigid shaft construction delivers a maximum of spindle power application, permits extremely fast and efficient stock removal, and makes possible corrections of large amounts of error such as out-of-roundness, snakiness, bell mouth and taper. Bore accuracy may be held easily within the range of 0.0001 to 0.0005-inch limits in most applications.

LOWER OPERATING COSTS

The above features with their many refinements permit Jes-Cal size control honing tools to record much lower operating costs in production as compared with previous experience.

Write for Bulletin JC-101

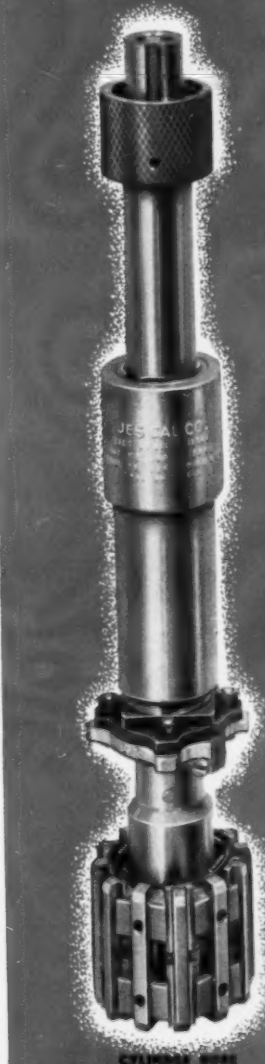


JES-CAL PLASTIC MOUNTED STONES WITH LEADING EDGE AND SIDE OPEN

SMALL DIAMETER SIZE CONTROL HONING TOOL

CON ROD SIZE CONTROL HONING TOOL

JES-CAL
SIZE CONTROL
HONE



CYLINDER BORE SIZE CONTROL HONING TOOL

JES-CAL COMPANY

31485 GROESBECK HIGHWAY • FRASER, MICHIGAN

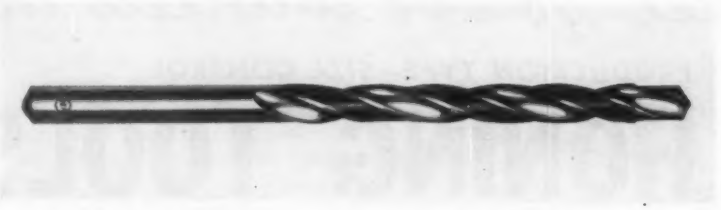
of usefulness falls into three general categories: (1) polishing and surface improvement; (2) fine finish of about 3 to 4 micro-inches; and (3) stress relief. Deburring and polishing can also be done on the inside diameters of parts, such as inside gears and hydraulic pistons.

The machine uses a fine abrasive media—normally between 8 and 14 mesh—to obtain high polishing and fine surfacing results on all steel parts during the deburring process. A single operator, working from one control station, can operate the Roto-Matic by using the controls on the push-button panel shown in the illustration.

The standard machines are equipped with four, eight, or sixteen spindles and operate on time cycles ranging from a few seconds to six minutes. With one part held in a fixture at each spindle, a 16-spindle machine operating on a 4-minute cycle would produce a minimum of 240 completed pieces per hour. With two parts to a spindle, production is 480 pieces per hour.

The fixture-actuating mechanism is air-operated and is automatic, or linked to a foot pedal at the operator's station. This works in conjunction with a cam-operated, automatic spindle-raising and lowering device also located at the operator's station.

Circle Item 137 on postcard, page 179



"Double Margin" special-purpose drill announced by Whitman & Barnes

Whitman & Barnes Drills

"Double Margin" special-purpose drills constructed with a margin on the leading and trailing edges of each land have been announced by Whitman & Barnes, Plymouth, Mich. The double margin gives the drill added bearing surface and for this reason is said to be especially useful in applications where maximum accuracy of drill alignment through the bushings is desired. Double margin drills are also reported to aid in obtaining holes closer to the drill size. According to the manufacturer, these tools are now being used extensively in the aircraft industry for skin and frame drilling. All "Double Margin" drills are considered special. They can be furnished in either single-diameter or step-drill style in a wide range starting at the 5/32-inch diameter size.

Circle Item 138 on postcard, page 179

Potter & Johnston High-Speed Automatic Turret Lathe

The development of a small, heavy-duty automatic turret lathe, to be known as the Model 3E-15, is announced by the Potter & Johnston Co., Pawtucket, R. I. This machine is designed specifically for high-speed production of hard-to-machine tough alloy components. It has a 10-inch chuck capacity, 11 1/2-inch swing over the base ways, and is designed to maintain close tolerances, produce smooth finishes, and handle a wide variety of work in the small to medium size range.

The 15-hp headstock has all-electric speed clutches and precision-ground speed gears. The base is a heavy steel weldment. Rugged construction is used throughout to withstand the strains of hogging out tough metal with heavy feeds.

The independent front and rear cross-slides are individually adjustable along the base ways. A control mechanism allows the operator to set the front or rear slide for "on-time" or delayed movement relative to any turret face by merely turning a selector switch. There are four automatic speed changes and six automatic feeds for each set of change gears. The combined features of the 6-face turret, readily adjustable cross-slides and wide speed and feed ranges are said to give the machine versatility as well as the ability to handle complex cuts easily and efficiently.

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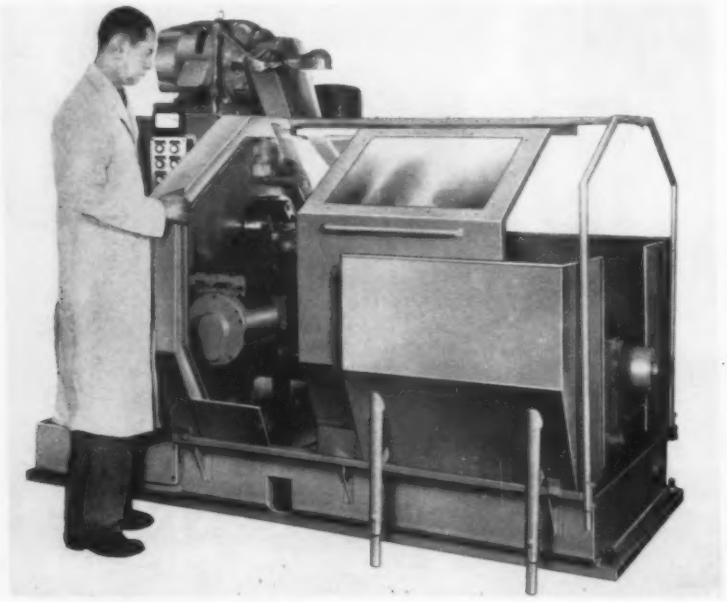
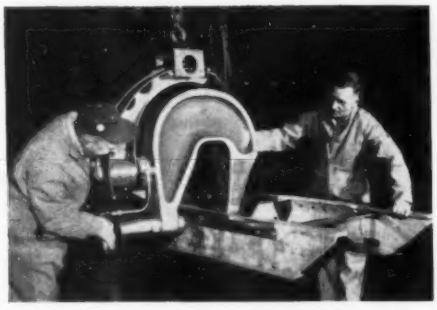


High-speed automatic turret lathe brought out by Potter & Johnston Co.

When the Kenworth Motor Truck Company builds truck frames they put extra "backbone" in them that you can count on for life. Cold rivets are the answer . . . they can't loosen from scale-off or shrinkage . . . they always stay tight.

THERE'S HOT NEWS IN CP COLD RIVETING



CP Hydraulic Cold Riveting equipment really puts the "squeeze" on assembly time and cost. Cold rivets are easier to handle . . . you can preload rows of rivets at a time to speed assembly. Holding power is consistent because there is no strength variation due to underheating or overheating. And you save manpower — there's no waiting for rivets to heat, no forge equipment or crew required. Cold rivets completely fill the holes . . . rivets don't work loose later. Unequal expansion and shrinkage problems are completely eliminated due to cold driving and pressure control. Hydraulic yoke locates quickly on the work—crescent suspension bail has universal swivel joint and counter-balance for fast positioning. For detailed information write: *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, New York.*

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

For more information fill in page number on Inquiry Card, on page 179

By E. S. Salichs

BETWEEN GRINDS

Seed for Thought

Buick is currently passing out to its dealers a pocket-piece containing a mustard seed with the inscription quoted from the *Bible*, "If ye have faith as a grain of mustard seed . . . nothing shall be impossible unto you." The *Oxford Dictionary* defines "seed" as a "small thing capable of vast development." Which completes the picture.

Sample Poses Weighty Problem

E. J. De Witt, promotion-minded president of Wallace Supplies Mfg. Co., backed up the announcement of his firm's new "See-Saw" (see page 192) by sending our editor a section of 18-inch channel cut off on the machine. The straight, gleaming surfaces of the sample speak well for the equipment. At the moment, the big problem, as we see it, is what to do with the section, which is about 1 inch long and weighs about 4 pounds. Suspended from the side of a rowboat, it might prove just the right weight for a leisurely afternoon of trolling this summer, although we shudder to think of subjecting those mirror-like surfaces to the mercy of the elements. Another school of thought would invert the section, weld it to a steel baseplate, and peddle it to Ye Antique Shoppe as a boot scraper. We salute Mr. De Witt's enterprise with his sample channel section.

Trackless Leaves Tracks

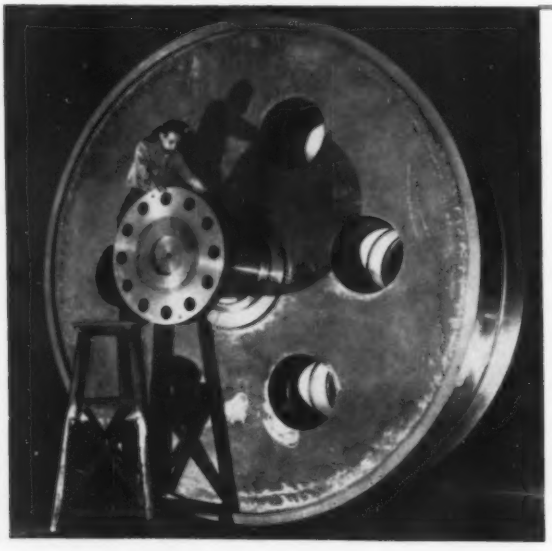
The Army Transportation Corps is now operating a trackless freight train (three are known to be in existence) high above the Arctic Circle, capable of carrying military supplies across the deep snows. According to *Steelways*, the train measures a city block in length, is powered by a 600-hp diesel engine, and has a transparent dome in the roof of the control car. Thus, the engineer may navigate by the stars when necessary, say, at night.

Mix-Match?

Automobile tires may now be tinted, *Chemical News* tells us, by the addition of a silica pigment that makes possible the production of rubber compounds in virtually any color. Guess what we want for Christmas—two red and two green tires.

Try-Out for Trouble

A portable, electronic burglar alarm, the Mark 16, which can be hooked up to any object such as a desk drawer, file cabinet, safe, or bed, activates lights, bells, cameras, and other devices merely by the approach of the human body (proximity fuse principle). Thieves, kidnappers, snoopers, beware!



THE BIG WHEEL—And just one of the two which will help propel the SS "Argentina," and then two more for the SS "Brasil," all manufactured by the General Electric Co. at its Medium Steam Turbine, Generator and Gear Department, Lynn, Mass., for the expanding passenger-cargo fleet of Moore-McCormack Lines, Inc. Aboard ships, the rotating speeds of the main propulsion turbines are much higher than those of the highest propeller speeds, and reduction gearing must be employed to permit use of the high-speed turbines. The gear wheel shown is 12 feet in diameter and weighs 27 tons.

Check...

COST-PER-PIECE

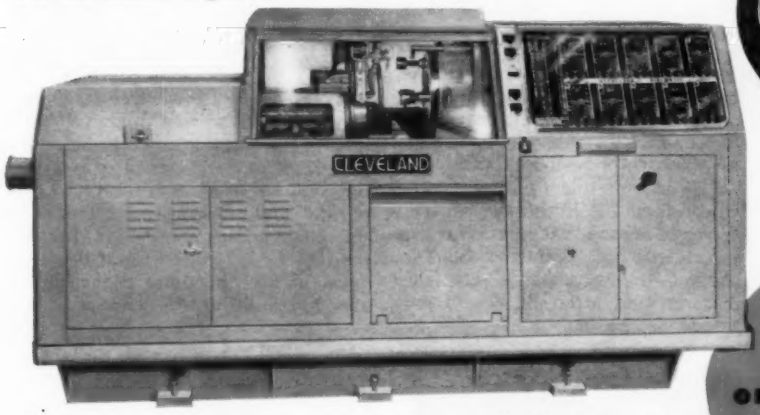
...it's usually LESS on the
NEW 1⅜" or 1⅝" model AB

CLEVELAND DIALMATIC

Analyze each of your jobs on its own. Figure it on a new 1⅜" or 1⅝" Model AB Cleveland Dialmatic single spindle automatic, and compare the best other methods you can use. Chances are you will get a much lower unit cost on the Cleveland—even on runs as small as 50 pieces!

Dial control is the answer. With this new Cleveland you save set-up time because there are *no change gears, no special cams to install.* You simply *set the dials* to pre-select any tool feed or spindle speed that you want, forward or reverse, for each of the five turret positions . . . the *exact* feeds and speeds for all types of tools, all kinds of metals. Then set the timing dogs and you are programmed for fully automatic machining—faster, more accurate production with fewer rejects.

Apply the many cost-cutting features of the new Model AB to your jobs. Get full information—write for the new 1⅜" and 1⅝" Model AB Cleveland Bulletin, or, better still, get in touch with a Cleveland sales engineer.



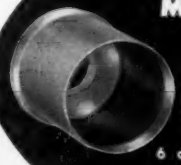
STAINLESS?

TIP ⅜" diameter, #416 stainless steel. 107 pieces per hour gross on 1⅛" Model AB. 6 operations include taper turn, end form, thread roll.

TOUGH ALLOY?

PILOT 1⅛" diameter x 4⅛" long, SAE 8620 steel. 15 pieces per hour gross on 1⅜" Model AB. 7 operations include box mill, cross turn, thread.

MILD STEEL?



HOUSING 1½" diameter, SAE 1020 steel. 15 pieces per hour gross on 1⅜" Model AB. 6 operations include heavy drill, deep form, tap.

BRASS

THREADED BUSHING ⅝" hex, free machining brass. 225 pieces per hour gross on 1⅛" Model AB. 7 operations.

or ALUMINUM?

RETAINER 1½" diameter, 245-T4 aluminum. 65 pieces per hour on 1⅛" Model AB. 7 operations.

ONLY the 1⅜" and 1⅝" Model AB CLEVELAND DIALMATICS provide—

EXACT SPINDLE SPEEDS—infinitely variable between 40 and 3200 rpm. Automatic changes and reversals.

EXACT TURRET FEEDS—actually tuned to each cut. No cam changes with Cleveland's universal camming.

OTHER PRODUCTIVITY FEATURES—independently controlled front and rear cross slides . . . independent cutoff slide . . . easy handcrank adjustment of stock feed . . . quick-change collets and feedshells . . . only 6.3 second idle motion time . . . Geneva turret indexing mechanism . . . and a host of other design features which assure long-lived accuracy—low maintenance costs.

Remember,
CLEVELANDS CUT COSTS!

THE CLEVELAND AUTOMATIC MACHINE COMPANY

4936 Beech Street
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SALES OFFICES: CHICAGO
CLEVELAND • DETROIT
HARTFORD • S. ORANGE

Manufacturers of a Complete Line of Single Spindle Automatic Screw Machines and High Pressure Hydraulic Die Casting Machines

For more information fill in page number on Inquiry Card, on page 179

News OF THE INDUSTRY

California

GARRETT CORPORATION, Los Angeles, Calif., announces the appointment of HARRY H. WETZEL as manager of the company's AiResearch Manufacturing Division. He succeeds CLAUDE N. MONSON, who has been appointed vice-president in charge of contract administration. Mr. Wetzel, who had previously been manager of Garrett's AiResearch Industrial Division, was succeeded in that position by WILTON E. PARKER, formerly sales manager and chief engineer.

Georgia and Alabama

PRODUCTO MACHINE CO., Bridgeport, Conn., in conjunction with SOUTHERN TOOL DISTRIBUTING CO., Atlanta, Ga., will operate a die set assembly warehouse in the latter city beginning May 1 to provide a faster service for manufacturers in the southeastern states. The warehouse will also service Producto distributors in North Carolina, South Carolina, Tennessee, Alabama, Mississippi, and Florida. It will be located at 54 Eleventh St., N. E. Atlanta.

J. M. CROCKETT, assistant to vice-president—gases of Air Reduction Sales Co., has been appointed manager of their Birmingham district as of April 1. Mr. Crockett replaces W. L. POOLE who has been named sales consultant for the Birmingham district. Both will be located at 124 South 16th St., Birmingham, Ala.

Illinois

LINK-BELT CO., Chicago, Ill., has announced that ROBERT F. GLADFELTER has been elected president; and JOHN M. SMALL vice-president, treasurer, and a director of Detroit Power Screwdriver Co., subsidiary of Link-Belt Co. Mr. Gladfelter succeeds ROY W. BAILEY, one of the founders of Detroit Power Screwdriver Co., who is retiring, after having been president since 1926. Mr. Gladfelter is also a director and secretary of the company.

AMERICAN MACHINE & METALS, INC., East Moline, Ill., has announced that I. NEWTON BECKER, formerly vice-president of operations, has been elected to the newly created position of executive vice-president. PHILIP C. CLARKE is now vice-president and general manager of the company's Hunter Spring Co. Division.

BESLY-WELLES CORPORATION, South Beloit, Ill., has announced the following appointments: EDWARD K. WELLES has been elected chairman of the board of directors and chief executive officer of the company, and WARREN C. OLSON, formerly executive vice-president, has been elected president and chief administrative officer. Other officers of the company re-elected were: EVERETT ADDOMS, senior vice-president in charge of Cutting Tool Division; SIDNEY M. NAPP, vice-president in charge of Machine Tool Division; NORMAN C. MINEHART, vice-president in charge of Abrasives Division; RALPH W. YOUNG, vice-president and engineering consultant; E. KENNETH WELLES, JR., treasurer; DONALD P. WELLES, JR., secretary; J. WALDRON JULIAN, assistant secretary and assistant treasurer; and MILO R. WARDLOW, general superintendent.

GEORGE C. ZENTZ has been appointed methods department supervisor for Clearing Machine Corporation, a division of U. S. Industries, Inc., Chicago, Ill. He has been an engineer with Clearing Machine Corporation for the past three years.

RICHARD Y. NEILEY has been appointed district sales supervisor by Sperry Products, Inc., Danbury, Conn. He will have headquarters in Chicago.

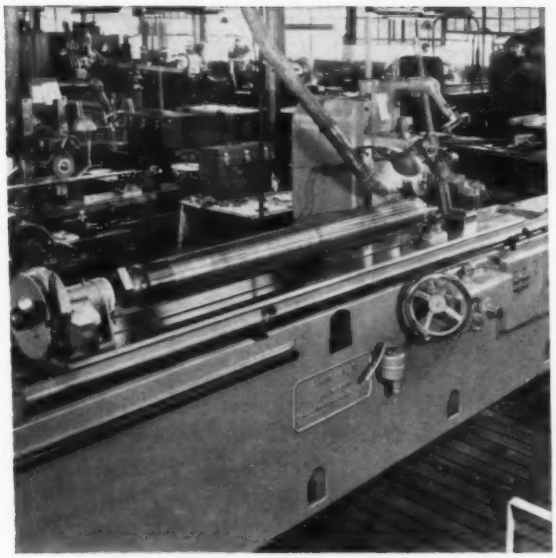
Michigan

FORD MOTOR COMPANY, Dearborn, Mich., announces realignment of Ford Motor Company manufacturing activities, including changes in executive responsibilities, and the election of a new vice-president. D. S. HARDER, who has retired and has resigned as executive vice-president of the company, will continue to serve on the staff as vice-president and technical adviser to the chairman of the board and the president. RAY H. SULLIVAN, vice-president of the company in charge of the former engine and foundry and metal-stamping groups, who will retire shortly, has been relieved at his request of his direct-line responsibilities. Mr. Sullivan will continue as a

(Continued on page 210)

(Left) Edward K. Welles, chairman of board of directors and chief executive officer, and (right) Warren C. Olson, president and chief administrative officer, Besly-Welles Corporation

IF YOU GRIND BROACHES AND SPLINES...

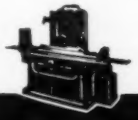


Battery of Grand Rapids Broach and Spline Grinders at Apex Broach Co., Detroit, Mich.

. . . take a cue from many of the nation's best known producers who use the only machine specifically built for broach and spline grinding. It's the Grand Rapids Broach and Spline Grinder, the only one of its kind — and the machine that offers so many features for faster, easier, big volume, high quality grinding that you'll soon see why it's preferred over machines merely adapted for broach and spline grinding.

Working surface of its table is 7″ wide x 72″, 90″ or 120″ long. Table speed is infinitely variable up to 70 fpm. Column is rugged one-piece casting. Vickers hydraulic pump with our own control valve. Separate hydraulic system for easy maintenance. Sealed-for-life spindle. And, of course, it's available engineered to your individual requirements.

May we tell you more? A note on your letterhead will bring full details.



GALLMEYER & LIVINGSTON

GALLMEYER & LIVINGSTON CO.

305 Straight Ave., N.W. Grand Rapids, Mich.

Weldynamics

ARC WELDING AT WORK CUTTING COSTS

A special Jetweld for deep groove welds

Jetweld 2 is a special electrode designed particularly for groove welding. The high deposition rate gives maximum speed in fabrication. The excellent wash-up characteristic and complete freedom from undercut makes the slag easy to remove. Deposits are uniformly of X-ray quality.

No electrode gives faster welding and lower cleaning time. Try Jetweld 2 in your shop.

Lincoln men, trained in Weldynamics, will help you select the best electrode, machine and procedures for lowest welding costs.

Write for Bulletin 7000.1, New Weldirectory of Lincoln Mild Steel Electrodes.

The World's Largest Manufacturer of Arc Welding Equipment

LINCOLN®

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THE LINCOLN ELECTRIC COMPANY, DEPT. 1228, CLEVELAND 17, OHIO

For more information fill in page number on Inquiry Card, on page 179

STANDARD TYPES OF STAINLESS STEEL*

Chemical Ranges and Limits; Typical Applications

		CORROSION RESISTANCE	MODIFIED FOR WELDING			
		316	304	321	347	405
Composition Per cent	Chromium	16-18	18-20	17-19	17-19	11.5-14.5
	Nickel	10-14	8-12	9-12	9-13	—
	Carbon	.08 Max	.08 Max	.08 Max	.08 Max	.08 Max
	Manganese	2 Max	2 Max	2 Max	2 Max	1 Max
	Silicon	1 Max	1 Max	1 Max	1 Max	1 Max
	Phosphorus	.045 Max	.045 Max	.045 Max	.045 Max	.04 Max
	Sulfur	.03 Max	.03 Max	.03 Max	.03 Max	.03 Max
	Other	Mo 2-3		Ti 5xC Min	Cb 10xC Min	Al .1-.3
Sheets & Strip (Annealed)	Tensile Strength, Psi	90,000	85,000	90,000	95,000	65,000
	Yield Strength, Psi	40,000	35,000	35,000	40,000	40,000
	Elongation, Per cent in 2 inches	50	50	50	45	25
	Rockwell Hardness	B-85	B-80	B-80	B-85	B-75
Bars & Plates (Annealed)	Tensile Strength, Psi	80,000	85,000	85,000	90,000	70,000
	Yield Strength, Psi	30,000	35,000	35,000	35,000	40,000
	Elongation, Per cent in 2 inches	60	60	55	50	30
	Rockwell Hardness	B-78				
	Endurance Limit, Psi	38,000	34,000	38,000	39,000	
Creep Strengths Psi; Load For 1% Elongation in 10,000 hrs.	1000 F	25,000	17,000	18,000	19,000	
	1100 F	18,200	12,000	13,000	14,000	
	1200 F	12,700	7,000	8,000	8,200	
	1300 F	7,900	4,000	4,500	4,600	
	1500 F	2,800	1,200	850	1,500	
Temperatures, Degrees F	Initial Forging	2100-2300	2100-2300	2100-2300	2100-2300	1950-2050
	Annealing		1850-2050			
	Low Anneal	1850-2050		1750-1950	1850-2050	1350-1500
	Hardening					
	Tempering					
	Stabilizing			1550-1650	1550-1650	
	Stress-Relief Anneal	400-750	400-750	400-750	400-750	
	Melting Range	2500-2550	2550-2650	2550-2600	2550-2600	2700-2790
	Max. Continuous Service in Air	1700	1700	1700	1700	1300
	Max. Intermittent Service in Air	1600	1600	1600	1600	1500
Miscellaneous Physical Properties	Modulus of Elasticity Tension, Psi	28×10^6	28×10^6	28×10^6	28×10^6	29×10^6
	Torsion, Psi					
	Density, lbs./cu.in	.29	.29	.29	.29	.28
	Specific Electrical Resistance, Microhms/cm/cm²	74	72	72	73	60
	Specific Heat Btu/lb./Deg. F	.12	.12	.12	.12	.11
	Thermal Conductivity Btu/Hr./Sq.Ft./Ft./Deg. F.	9.4	9.4	9.3	9.3	
	Mean Coeffcient of Expansion					
	32—212F	8.9×10^{-6}	9.6×10^{-6}	9.3×10^{-6}	9.3×10^{-6}	6.0×10^{-6}
	32—600F	9.0×10^{-6}	9.9×10^{-6}	9.5×10^{-6}	9.5×10^{-6}	6.4×10^{-6}
	32—1000F	9.7×10^{-6}	10.2×10^{-6}	10.3×10^{-6}	10.3×10^{-6}	6.7×10^{-6}
	32—1200F	10.3×10^{-6}	10.4×10^{-6}	10.7×10^{-6}	10.6×10^{-6}	
	32—1500F	11.1×10^{-6}		11.2×10^{-6}	11.1×10^{-6}	7.5×10^{-6}

*This table continued from May, 1958, MACHINERY

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STANDARD TYPES OF STAINLESS STEEL*

Chemical Ranges and Limits; Typical Applications

		ELEVATED TEMPERATURES		COLD WORKING	HARDENABLE BY HEAT TREATMENT			
		310	446	301	420	440 A	440 B	440 C
Composition Per cent	Chromium	24-26	23-27	16-18	12-14	16-18	16-18	16-18
	Nickel	19-22	—	6-8	—	—	—	—
	Carbon	.25 Max	.2 Max	.15 Max	Over .15	.60-.75	.75-.95	.95-1.2
	Manganese	2 Max	1.5 Max	2 Max	1 Max	1 Max	1 Max	1 Max
	Silicon	1.5 Max	1 Max	1 Max	1 Max	1 Max	1 Max	1 Max
	Phosphorus	.045 Max	.04 Max	.045 Max	.04 Max	.04 Max	.04 Max	.04 Max
	Sulfur	.03 Max	.03 Max	.03 Max	.03 Max	.03 Max	.03 Max	.03 Max
	Other		N .25 Max			Mo .75 Max	Mo .75 Max	Mo .75 Max
Sheets & Strip (Annealed)	Tensile Strength, Psi	95,000	80,000	110,000				
	Yield Strength, Psi	45,000	50,000	40,000				
	Elongation, Per cent in 2 inches	45	20	60				
	Rockwell Hardness	B-85	B-83	B-85				
Bars & Plates (Annealed)	Tensile Strength, Psi	95,000	80,000	105,000	95,000	105,000	107,000	110,000
	Yield Strength, Psi	45,000	50,000	40,000	50,000	60,000	62,000	65,000
	Elongation, Per cent in 2 inches	50	25	55	25	20	18	14
	Rockwell Hardness	B-89	B-86		B-92	B-95	B-96	B-97
	Endurance Limit, Psi		47,000	39,000				
Creep Strengths Psi; Load For 1% Elongation in 10,000 hrs.	1000 F	17,000	6,000					
	1100 F	13,000	3,000					
	1200 F	9,000	1,500					
	1300 F	5,000	700					
	1500 F	1,000	300					
Temperatures, Degrees F	Initial Forging	2000-2250	1950-2050	2100-2300	2000-2200	1900-2200	1900-2150	1900-2100
	Annealing			1850-2050	1550-1650	1550-1650	1550-1650	1550-1650
	Low Anneal	1900-2100	1450-1600		1350-1450	1350-1450	1350-1450	1350-1450
	Hardening				1800-1900	1850-1950	1850-1950	1850-1950
	Tempering				300-700	300-800	300-800	300-800
	Stabilizing							
	Stress-Relief Anneal	400-750		400-750				
	Melting Range	2550-2650	2600-2750	2550-2590	2650-2750	2500-2750	2500-2750	2500-2700
	Max. Continuous Service in Air	2100	2000	1700	1200	1400	1400	1400
	Max. Intermittent Service in Air	1900	2150	1600	1400	1500	1500	1500
Miscellaneous Physical Properties	Modulus of Elasticity Tension, Psi	29×10^6	29×10^6	28×10^6	29×10^6	29×10^6	29×10^6	29×10^6
	Torsion, Psi				11.7×10^6			
	Density, lbs./cu.in.	.29	.27	.29	.28	.28	.28	.28
	Specific Electrical Resistance, Microhms/cm/cm³	78	67	72	55	60	60	60
	Specific Heat Btu/lb./Deg. F	.12	.12	.12	.11	.11	.11	.11
	Thermal Conductivity Btu/Hr./Sq.Ft./Ft./Deg. F.	8.0	12.1	9.4	14.4	14.0	14.0	14.0
	Mean Coeffcient of Expansion							
	32—212F	8.0×10^{-6}	5.8×10^{-6}	9.4×10^{-6}	5.7×10^{-6}	5.6×10^{-6}	5.6×10^{-6}	5.6×10^{-6}
	32—600F	9.0×10^{-6}	6.0×10^{-6}	9.5×10^{-6}	6.0×10^{-6}			
	32—1000F	9.4×10^{-6}	6.2×10^{-6}	10.1×10^{-6}	6.5×10^{-6}			
	32—1200F	9.7×10^{-6}	6.4×10^{-6}	10.4×10^{-6}	6.8×10^{-6}			
	32—1500F							

*This table continued from May, 1958, MACHINERY

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XLO EX-CELL-O FOR PRECISION

B

C

A

D

F

A. Standard DB 24 Spindle
B. DB 50 Motorized Spindle
C. DB 25 Square Body Spindle
D. DB 50 Motorized Quill-Type Spindle
E. DB 22 Square Body Spindle
F. Standard DB 22 Spindle

E

57-90

Greater Accuracy—with Ex-Cell-O Precision Boring Spindles

No one need tell you of the proven superiority of Ex-Cell-O precision boring spindles where close tolerances and fine finishes are required. But, did you know that these same Ex-Cell-O boring spindles have been used as replacement units for years?

Produced in belt-driven, standard motorized, or high frequency motorized styles, these Ex-Cell-O precision spindles are equipped with XLO Precision bearings for maximum spindle rigidity, long life and smooth operation. Permanent bearing lubrication reduces maintenance costs, prolongs bearing life.

For complete information, why not get in touch with your local Ex-Cell-O representative or, if you prefer, send direct for bulletin 25477.

EX-CELL-O CORPORATION *Machinery Division*
DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES CUTTING TOOLS • TORQUE ACTUATORS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

company vice-president and will collaborate with Mr. Harder on special manufacturing projects. JOHN DYKSTRA, formerly vice-president in charge of the transmission and axle group and Aircraft Engine Division, has been appointed vice president—manufacturing staff. Mr. Dykstra will continue to direct the Aircraft Engine Division. He also will have responsibility for defense planning and sales, the production programming and control office, plant engineering, manufacturing engineering and quality control, as well as functional supervision of Aeronutronic Systems, Inc., a company subsidiary. The realignment of the company's manufacturing operations includes a rearrangement of plants into six manufacturing divisions. The six divisions, in turn, become components of two new groups—the Power Train Group and the Body Group. C. H. PATTERSON has been elected a vice-president of the company. He formerly was group executive for the engine and foundry group, and will now head the new Power Train Group, which will include the Engine and Foundries Division, with M. L. KATKE as general manager, and the Transmission and Chassis Division, headed by R. J. HAMPSON as general manager. A new manufacturing research office has been established with responsibility for advanced production engineering projects, manufacturing research and development of manufacturing processes. This office will be headed by D. J. DAVIS, who continues as a company vice-president.

HERBERT A. BEYER, JR., has been named vice-president in charge of sales and a director of DeVlieg Machine Co., Detroit, Mich. He had previously served as sales manager. His new duties will be to coordinate and direct all sales of Microbore tools and DeVlieg machines.

Herbert A. Beyer, Jr., has been named vice-president—sales, and director, DeVlieg Machine Co.

(Left) Edward I. Brown, director of engineering, Machinery Hydraulics Division, and (right) Gordon H. Clayton, general manager, Electric Products Division, Vickers Incorporated

NATIONAL BROACH & MACHINE CO., Detroit, Mich., has announced a new production facility designed to meet the need for both accurate and ultra-precision gears in low and moderate production quantities. The new facility now enables National Broach to provide a complete gear production service. This will include development of cutting tools and of special tooth forms for heavy-load applications, recommendations for tolerance specifications, analysis of gear designs for gears ranging from the very smallest to those having high helix angles and large pitch diameters.

EX-CELL-O CORPORATION, Detroit, Mich., has announced the appointment of L. GRAHAM COLLINS as a sales representative in the New York–New Jersey area. Mr. Collins will be working with W. M. (Bill) THOMPSON, district manager. The New York office handles the products of Ex-Cell-O, the Continental Tool Works Division, Bryant Chucking Grinder Co., and Cadillac Gage Co., the latter two subsidiaries of Ex-Cell-O.

WILLIAM F. ROGGE has been named general manager of the Industrial Division of Aeroquip Corporation, Jackson, Mich. His duties will include responsibility for the Industrial Division's manufacturing plant in Van Wert, Ohio, and the Industrial Sales Division.

VICKERS INCORPORATED, Detroit, Mich., has announced the following appointments: EDWARD I. BROWN, as director of engineering for the Machinery Hydraulics Division, and GORDON H. CLAYTON, as general manager, Electric Products Division.

FREELAND GAUGE CO., Detroit, Mich., has announced the appointment of QUALITY CONTROL CORPORATION, 401 Broadway, New York City, as their exclusive representative. The territory will consist of New York State counties of Orange, Putnam, Rockland, Westchester, Bronx, Kings, Queens, Richmond, Nassau, and Suffolk.

New England

REED-PRENTICE, Division of Package Machinery Co., Worcester, Mass., has announced plans to consolidate all Reed-Prentice operations at the parent company's plant in East Longmeadow, Mass. This plant covers approximately 400,000 square feet and is situated on a 40-acre tract.

NORTON CO., Worcester, Mass., has announced the creation of a new department and several personnel changes in the company's Abrasive Division sales organization. ROBERT G. VAN KEUREN will head the newly created product-engineering department as manager of product engineering. FRANK G. GUSTAFSON has been named supervisor of sales engineering. JOHN CLARK, JR., has been appointed head of the vitrified products section of the product engineering department, assuming the former duties of Mr. Gustafson.

Robert F. Reid, manager, machine tool sales, Union Twist Drill Co.

ROBERT F. REID has been appointed manager, machine tool sales, of the Union Twist Drill Co., Athol, Mass. Mr. Reid is to be in full charge of all sales activities in connection with the marketing of Union Twist Drill cutter grinders and other grinding equipment. He comes to the company with an extensive background in the machine tool sales field.

MARTIN T. SCHUMB has been appointed chief consulting engineer of the Boston Gear Works, Quincy, Mass. S. GEORGE BELEZOS succeeds him as chief engineer. Mr. Schumb has directed the engineering operations at Boston Gear for the past thirty-five years.

AUGUST DAVID DIEDRICH, JR., has joined the Michigan district sales organization of the Bay State Abrasive Products Co., Westboro, Mass.

PRATT & WHITNEY CO., INC., West Hartford, Conn., has announced the appointment of new managers for two of the company's district sales offices in Rochester and Cincinnati. FRED D. WATSON, formerly on the sales staff of the Milwaukee office of the company, has been named district manager of the Rochester branch. JAMES H. DALEY, formerly of the sales staff of the Rochester territory, has been named to succeed E. W. CHAMBERS, district manager at Cincinnati, who is retiring. Three sales representatives from the Hartford office are being transferred to the district branches: RICHARD N. ST. LOUIS and RAYMOND K. STEITZ will go to Rochester, and PATRICK MULDOON will go to Cincinnati. LAURENCE D. GILLANE, who has represented the company in Syracuse, will replace Mr. Watson at Milwaukee.

AUSTIN R. ZENDER, formerly executive vice-president of the Bridgeport Brass Co., Bridgeport, Conn., was elected president of the company. Mr. Zender succeeds HERMAN W. STEINKRAUS who has been president of the company since 1942. Mr. Steinkraus will continue to serve as chairman of the board, general manager, and chief executive officer.

New York and New Jersey

ANACONDA CO., New York City, has announced the following appointments: JOHN A. COE was elected chairman of the board of directors of the American Brass Co. Mr. Coe, president of the concern since 1950, will continue as the company's chief executive officer. RICHARD M. STEWART has been elected president of American Brass. He is a director of the company and, until his election, was director of industrial relations of the Anaconda Co. Mr. Stewart will take over his new position at the company's headquarters in Waterbury, Conn. The American Brass Co. is a wholly owned subsidiary of the Anaconda Co.

ALCO PRODUCTS, INC., Schenectady, N. Y., has announced the election of PERRY T. EGBERT as chairman and WILLIAM S. MORRIS as president. Mr. Egbert had been president of the company and Mr. Morris, executive vice-president.

REVERE COPPER & BRASS INC., New York City, has announced the appointment of RICHARDS & CONOVER STEEL DIVISION, Kansas City, Mo., as its aluminum warehouse distributor for the Missouri Valley area. The facilities and planning of this organization will afford maximum service to aluminum users in this nine-state area.

CARL CLAUS has been elected a vice-president of the Babcock & Wilcox Co., New York City. Mr. Claus will continue to direct the activities of the Staff Division, which provides essential services to all divisions of the company.

RUSSELL, BURDSALL & WARD BOLT AND NUT CO., Port Chester, N. Y., has announced the election of W. GOULD JONES as vice-president in charge of sales. HARRY O. MCCULLY, whose position Mr. Jones assumes, has been elected senior vice-president.

Ohio

CINCINNATI MILLING & GRINDING MACHINES INC., sales subsidiary of the Cincinnati Milling Machine Co., Cincinnati, Ohio, has elected PHILIP O. GEIER, JR., and W. KENT MATHIAS, vice-presidents. Mr. Geier has also been elected a director. He has been associated with the parent company since 1939 and is manager of its Products Division. Mr. Mathias has been associated with the parent company in various positions since 1937, and is manager of its Grinding Machine Division.

(Left) W. Kent Mathias, vice-president, and (right) Philip O. Geier, Jr., vice-president and director, Cincinnati Milling & Grinding Machines, Inc., subsidiary of the Cincinnati Milling Machine Co.

NATIONAL SCREW MACHINE PRODUCTS ASSOCIATION, Cleveland, Ohio, has announced the election of the following officers: as new president, C. J. BAUMGART, president of Screw Machine Engineering Co., Chicago; as vice-president, LEONARD R. SCHAFFER, president, Mechanical Art Works, Inc., Newark, N. J.; and ROLAND G. HERKER, vice-president and treasurer of Herker Screw Products, Inc., Milwaukee, as treasurer. Re-elected were ORRIN B. WERNTZ as counsel and executive vice-president of the Association, and MARGARET S. BALLINGER as secretary. Trustees were also elected. National headquarters for the Association is in the NSMPA Building, 2860 E. 130th St., Cleveland.

TIMKEN ROLLER BEARING CO., Canton, Ohio, announces construction of a new steel warehouse costing an estimated $275,000. The building will be located on the company's property at Gambrinus. It will include storage space and offices for warehouse and shipping personnel. Structure of the building, measuring 90 by 308 feet, is of a type requiring no internal supporting columns. A 90-foot crane will cover the full width of the new building and a new 18-inch band saw will be installed to cut stock.

FOSDICK MACHINE TOOL CO., Cincinnati, Ohio, has announced the appointment of FRANK J. FIELDS as president. Mr. Fields was formerly works manager of the company. Before joining Fosdick in the fall of 1957, he had been executive vice-president and general manager of the Sidney Tool Co., Sidney, Ohio.

Frank J. Fields, recently appointed president of the Fosdick Machine Tool Co.

YOUNGSTOWN FOUNDRY & MACHINE CO., Youngstown, Ohio, has announced that MAX DEHASS has been appointed vice-president—engineering. Other engineering appointments are: AXEL S. HELLSTROM, chief engineer; FRANK J. GENTILE, assistant chief engineer; WALTER M. KEIL, chief design engineer, roll-turning and contouring lathes; and STEPHEN POLESCHUK, chief design engineer, extrusion presses.

STANLEY E. HUFFMAN, JR., has been appointed manager of sales of the Press Division, E. W. Bliss Co., Canton, Ohio. Mr. Huffman will be responsible for the administration of all selling policies of the Press Division, including the direction of the field sales organization.

OSCAR AHLERS has been appointed general manager of the Sheffield Corporation, Dayton, Ohio. This new assignment places under Mr. Ahlers' over-all supervision all sales, product divisions, and field service manufacturing facilities.

Pennsylvania

PHILADELPHIA GEAR WORKS, INC., Philadelphia, Pa., has changed its name to PHILADELPHIA GEAR CORPORATION. RUSSELL C. BALL, president, noted that the new corporate designation "more properly describes the company's activities in the mechanical power transmission field." The company operates two plants in the Philadelphia area and a third in Lynchburg, Va. A 30-acre tract bordering the Pennsylvania Turnpike was recently purchased for future expansion.

DECHERTS MACHINE SHOP INC., Palmyra, Pa., manufacturers of Robinson presses, has announced that they will now also manufacture the Zeh & Hahnemann press line. The line consists of the reclinable, arch, horn, screw, toggle, drawing, punching, reducing, open-back, double-crank, double-action, straight-side, patent percussion, and high-production presses (up to 600 spm) which Z & H introduced.

EDWIN J. DUNCAN has been appointed a metallurgical engineer for Latrobe Steel Co., Latrobe, Pa. His assignment covers technical services in the manufacture of high-speed and super-alloy steels.

C. WESLEY MURRAY has been appointed manager of knife sales for Heppenstall Co., Pittsburgh, Pa.

Wisconsin

EDWARD C. HELMKE has been appointed chief engineer of Gisholt Machine Co., Madison, Wis. Mr.

Edward C. Helmke, chief engineer, Gisholt Machine Co.

Helmke has been with Gisholt for twenty-three years. Joining the company in 1935, he served in various capacities including sales clerk, draftsman, assistant service manager, assistant to the works manager, and more recently as assistant chief engineer. He is well known to the metalworking industry through his association with Gisholt and as the author of the reference book, "Practical Dimensioning," as well as several technical articles that have appeared in various metalworking trade publications.

GIDDINGS & LEWIS MACHINE TOOL CO., Fond du Lac, Wis., has announced several administrative

Edgar L. McFerren, newly appointed vice-president—sales, Giddings & Lewis Machine Tool Co.

V-R TANTUNG Cast Alloy

is your best in-between* cutting tool material

*in-between

maximum speed for high speed steel and minimum speed for carbide

Here's what Tantung is. It is a cast alloy with high red-hardness, high transverse rupture strength, low coefficient of friction and high shock resistance.

TANTUNG bridges the gap between maximum cutting speeds possible with high speed steel and minimum speeds practical with carbides. Generally, TANTUNG can be started at speeds 50% higher than HSS and on many applications 100% higher.

Easily ground

TANTUNG is easy to grind, straight or to form, with aluminum oxide wheels. No diamond wheels required.

Lower tool cost

TANTUNG is available and stocked in solid tool bits, square, rectangular and round, permitting many regrinds, a variety of cut-off blades and tipped tools. Special shapes cast-to-form to your prints reduce grinding costs and insure longer tool life.

Many applications

TANTUNG will appreciably reduce machining costs on older machines which lack speed or rigidity to use carbide. TANTUNG is ideal for use on multiple operations where a wide variety of speeds are encountered.

SEND FOR LITERATURE

V-R Catalog

V-R Booklet—Where and How to Use Tantung Cast Alloy.

25 YEAR

MANUFACTURERS OF: CEMENTED CARBIDES, TOOLHOLDERS, AND TANTUNG® CAST ALLOY CUTTING TOOLS

Vascoloy-Ramet Corporation

SUBSIDIARY OF FANSTEEL METALLURGICAL CORPORATION

[illegible]44 Market Street • Waukegan, Illinois

T-661

changes affecting the company and two of its divisions, both in Fond du Lac: EDGAR L. MCFERREN has been named vice-president of sales for the corporation; he was formerly general manager of the G & L and Hypro Division. GEORGE K. CASSADY, now general manager of field sales for the corporation, was general manager of the Davis Boring Tool Division. Succeeding Mr. Cassady as general manager of the Davis Division is WALTER B. WIGTON, who has been chief engineer of the G & L and Hypro Division. Filling the position vacated by Mr. Wigton is WALTER L. MCCANN, formerly assistant chief engineer. WILLIAM M. RITTER was assigned as sales manager of the Davis Division. HARRY C. SOUKUP is acting general manager of the G & L and Hypro Division; he will continue also in his capacity of works manager of that same division.

Obituaries

Walter Ferris

Walter Ferris, co-founder, vice-president, and consulting engineer of the Oilgear Co., Milwaukee, Wis., died on April 16. Born in Rancocas, N. J., on March 21, 1868, Mr. Ferris graduated from Lehigh University in 1895. Later, while chief engineer of the Bucyrus-Erie Co., Mr. Ferris became interested in the development of hydraulic power transmissions. This interest led to the founding of the Oilgear Co., in 1921, with the late E. K. Swigart. Mr. Ferris remained active in the company until the time of his death. He had assigned over 140 patented inventions to the company since 1917. He also assigned inventions to his former employers.

Mr. Ferris invented the "hydraulic feed controller," an automatic-control device for putting mass production machines through their entire feed cycles by merely pushing a starting lever or push-button control. This was the real beginning of the automatic hydraulic feed now almost universally used. He designed the first hydraulic broaching machine. Today, almost all broaching machines are operated by hydraulic components. The basic inventions covering all Oilgear pumps, motors, and transmissions were made by him. The one most widely used is the "radial rolling piston" design incorporated in Oilgear pumps, motors, and variable-speed transmissions since 1933.

Mr. Ferris was an active member of many important professional societies and organizations.

James A. Scully

James A. Scully, board chairman of Scully-Jones & Co., Chicago, Ill., died at his home in suburban La-Grange Park in April at the age of eighty-one. Mr. Scully founded the firm in 1912 and served as president for many years before assuming the post of board chairman. A practical machinist who held executive posts in the metalworking industry several years before founding his company, Mr. Scully also designed many precision tools made by Scully-Jones.

Coming Events

JUNE 9-13—Fourth International Automation Exposition and Congress will be held in the Coliseum, New York City. For further information contact Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh 12, Pa.

SEPTEMBER 23-26—Association of Iron and Steel Engineers' 1958 Iron and Steel Exposition and Convention will be held in Public Auditorium, Cleveland, Ohio. The Association's address is 1010 Empire Building, Pittsburgh 22, Pa. The managing director: T. J. Ess; exposition manager: William C. Friesel.

New Books and Publications

THOMAS' REGISTER OF AMERICAN MANUFACTURERS (1958). 10,000 pages, 9 by 14 inches. Published by the Thomas Publishing Co., 461 Eighth Ave., New York 1, N. Y. Price $15 f.o.b. shipping point.

More than 70,000 products, covering all lines of manufacture in the United States, are classified in the forty-eighth annual edition of this informative purchasing encyclopedia. The material is published in five volumes, including the index to contents which facilitates convenient reference to the work.

The first three volumes list the names and addresses of manufacturers classified by products. The products are classified not only by generalized group names but by specific types, so that the prospective buyer can easily find the particular type that will meet his requirements. The names of the manufacturers under each product classification are arranged by states and cities, thus making it easy for a buyer to select a product within certain geographical boundaries if desired. All classifications are also thoroughly cross-indexed. A capacity or capital investment rating is given for each firm at each product listing.

The fourth volume contains an alphabetical list of manufacturers with branches, subsidiaries, and other data such as company officials and cable codes. It also gives an alphabetical list of trade names, together with export and other miscellaneous information that would be useful to the reader.

Volume five is an index to advertisers and a product-finding guide to the contents.

Buyers, engineering research departments, production executives, and all those who require a list of products or names of manufacturers for volume purchasing purposes will find this "where to buy" source an invaluable aid in their work.

KEMPE'S ENGINEERS YEAR-BOOK. Edited by C. E. Prockter under the direction of the editor of "The Engineer." Two volumes, 3000 pages. 4 3/4 by 6 7/8 inches. Published by Morgan Brothers, Ltd., 28 Essex St., Strand, London, W.C.2. Price, 82/6d, plus postage.

This standard British engineering reference work, under 79 chapter headings, covers the fields of electrical engineering, hydraulic engineering, mechanical engineering, railway engineering, electronic engineering, aerodynamical engineering, marine engineering, civil engineering, and various subsidiary subjects.

In this latest (63rd) edition, valuable additions have been made to the chapters on Welding and Cutting, Water Engineering, Iron and Steel, Non-Ferrous Metals and Alloys, Foundry Practice, Grinding Abrasives, Machine Tools, Wire Ropes, Harbors and Docks, Railway Engineering—Permanent Way, Aerodynamics, Aircraft Propulsion, Electronic Engineering, Atomic Power, Heating, Ventilation and Air Conditioning, Public Health Engineering, and Concrete and Reinforced Concrete.

This is a valuable general reference work that is exceptionally well indexed with over 17,000 entries.

Detroit Know-How at Work Assembling Tractors

Two hundred and fifty tractors a day flowing from Massey-Ferguson's newly expanded Detroit assembly plant should help to pull the Motor City out of its economic quagmire. Built in 1947, the plant was refurbished and expanded in 1957-1958 to meet the increasing demands of mechanized farming. Now double its original size (more than 350,000 square feet), it combines the most up-to-the-minute assembly, painting, testing, and materials-handling techniques found in the farm-equipment industry.

The plant's conveyor system is almost 2 miles long, with ninety-six individual stations for assembly and other functional operations. Engines are fed to the line by an overhead conveyor. After axles, transmissions, front ends, and the engines are bolted together to make the basic tractors, they are moved to the second floor for washing, painting, and baking. Simultaneously, another line is feeding other components through these processes. From a 28,000-square foot storage basement, machine-mounted tires are pre-selected automatically and delivered over four independent conveyor systems.

Back on the final-assembly floor conveyor, the tractor comes alive with the addition of seats, hoods, grilles, lights, and steering wheels. The finished machine then undergoes a precise check on its Ferguson-system hydraulics. Inspected and tagged, the tractors are driven off the line to waiting flat cars and truck transports.

Massey-Ferguson, the world's largest producer of tractors and combines, operates seventeen factories in seven countries. M-F president, A. A. Thornbrough, speaking at the dedication of the tractor plant last May 7, stated, "We have deliberately chosen to remain and expand in Detroit, and thus to take advantage of the great vigor and know-how so heavily concentrated in the workers and suppliers in the Detroit area. We believe Detroit is and will continue to be an excellent place in which to manufacture tractors."

Recent expansion in the Detroit area also includes the establishment this year of a transmission and axle plant. The company's new Industrial Division grew out of last year's acquisition of Mid-Western Industries, Inc., Wichita, Kan.

Course on Numerical Controls for Machine Tools

A one-week course on numerical machine tool control directed toward the engineer in the machine tool and allied industries will be offered from August 11 to 16 at Case Institute of Technology, Cleveland, Ohio. The course is intended to provide the engineer with information concerning design methods that will enable him to synthesize control systems for the automatic numerical operation of machine tools or processes.

Ten lectures and ten problem sessions will include the following topics: number systems, numerical codes, binary arithmetic, switching-circuit synthesis, truth takes, logical elements, counting circuits, parallel and serial addition circuits, bi-directional counting, binary frequency division, incremental and absolute systems, absolute encoding, reflected codes and their conversion, matrix code conversion, digital-to-analog data conversion, tape coding, and tape data computation by manual and high-speed digital computer methods. Registration in the program is open to a limited number of qualified persons having a college degree in engineering science.

Sheffield-Dearborn Patent Litigation Terminated

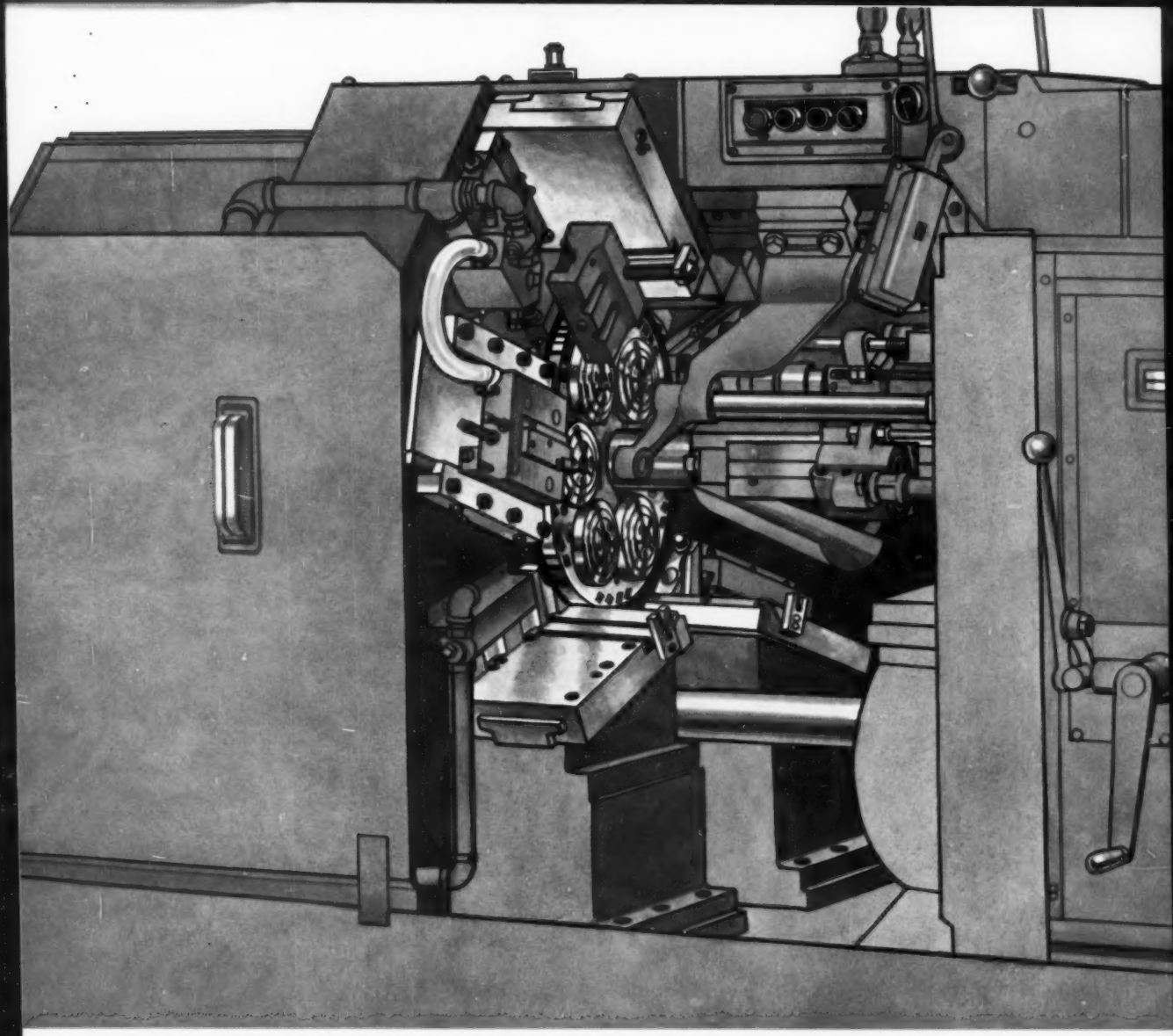
A patent infringement suit brought by the Sheffield Corporation, Dayton, Ohio, against Dearborn Gage Co., and Elmer Ellstrom and Olaf Ellstrom in June, 1956, in the United States District Court in Detroit, Mich., charging infringement by Dearborn of a group of Sheffield's patents, has been terminated by the entry of a consent judgment of validity and infringement of Sheffield's patents and the grant of a license by Sheffield to the Dearborn Gage Co., based on a royalty arrangement.

This is the new

MODEL

52

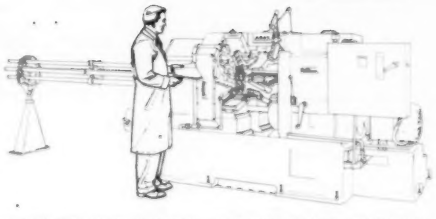
NEW BRITAIN



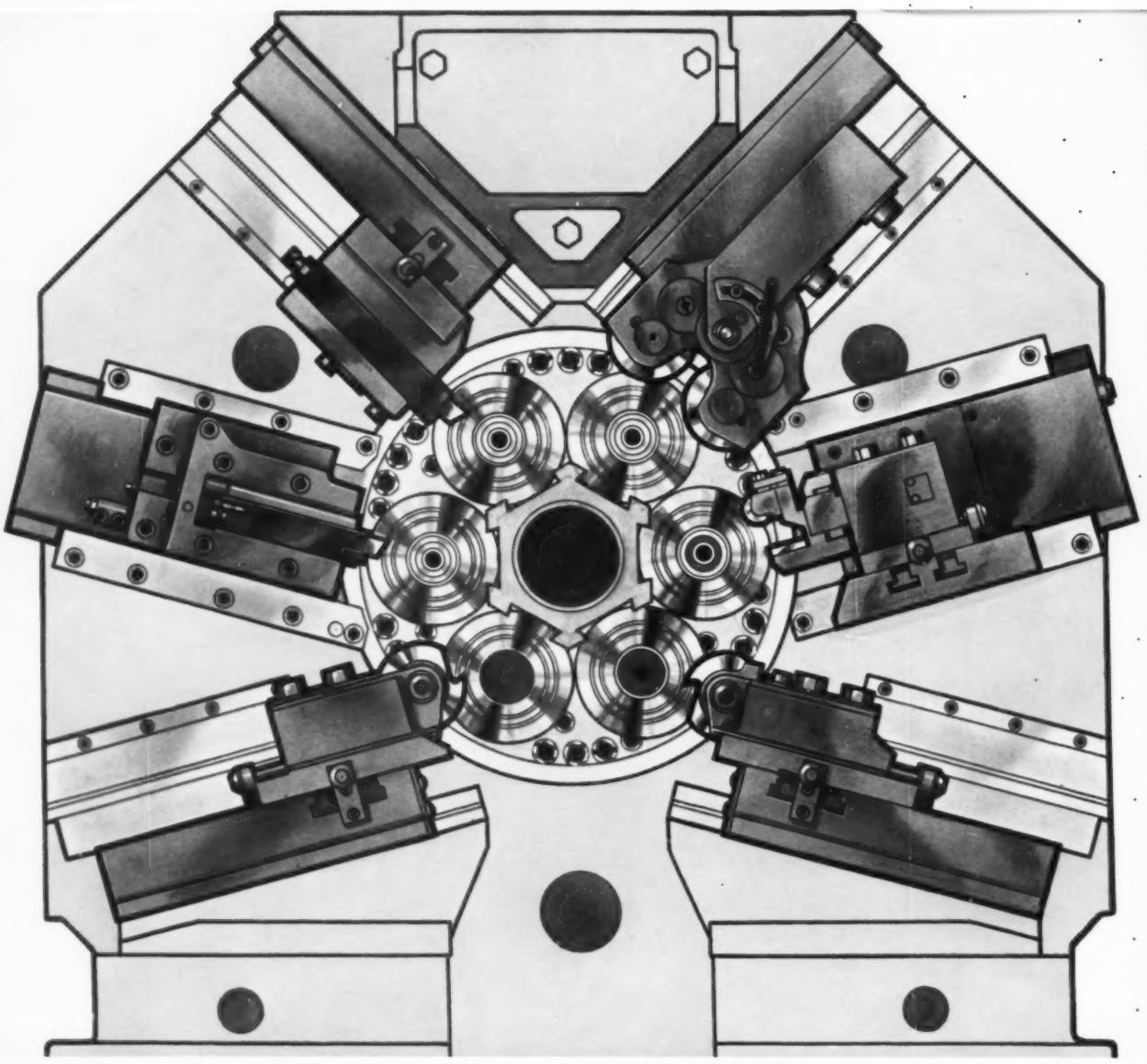
for New Britain accuracy in the 1" and 1¼" range

The new Model 52 gives you every feature of the most modern bar machine design.

Six independent radially-operated cross slides • Spindle speed range of 271-4249 r.p.m. • Spherical roller collet closing mechanism • Automatic stop • More efficient spindle spacing • Greater tooling area accessibility • Positive locating and locking of spindle carrier • Wear-preventing spindle carrier lifting mechanism. Turn the page for more information. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

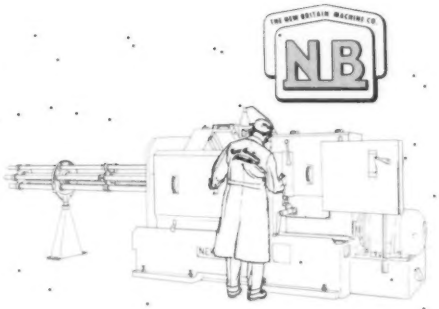


MODEL **52** NEW BRITAIN AUTOMATIC BAR MACHINE



more operations with a cross slide in every position

The New Britain 52-62 Series automatic bar machines offer you the advantages of a cross slide for every spindle, permitting practically unlimited tooling combinations. Completely independent of each other, and solidly mounted on the frame of the machine, these six cross slides permit more operations on a single machine with simpler tools and attachments. The readily accessible cross-slide cams permit more rapid change-over, too. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.



MODEL **62** NEW BRITAIN AUTOMATIC BAR MACHINE
1⅝" and 2¼"

This is an ideal time to have new-machine accuracy rebuilt into your New Britains by New Britain

Ruggedness and dependability have been built into every New Britain machine ever sold. For a fraction of the replacement cost you can have your older New Britains restored to new-machine accuracy. Rebuilding eliminates the high cost of frequent shutdowns and returns the machine to full efficiency, performing every operation it was designed to perform.

At New Britain your machines will be rebuilt with the same production facilities that originally built them. Established reconditioning procedures, based on long experience, will put your rebuilt machines back on the line in the shortest possible time. Wherever possible, your machine will have the benefits of the newest improvements in parts and assemblies.

With New Britain your rebuilt machines carry a new-machine warranty.

Your New Britain field engineer or sales representative will help you determine the rebuilding program best suited to your needs. Call him, or write or phone the factory direct, c/o Service Sales Manager, The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

What will your next press be like?

What will you expect of it?

What service conditions will it have to meet?

Now, and in the immediate future, here's what plants like yours are faced with:

. . . methods will change
. . . new materials will give birth to new products
. . . new markets will appear
. . . rising costs will demand higher productivity

The future of your company rests on what you can produce, how well, how quickly and how efficiently. The hydraulic presses you use will be increasingly important during these coming years. Check the Special Engineering features that BIRDSBORO design, *with the accent on versatility*, can give you. *Main Office, Engineering Department and Plant*: Birdsboro, Pa., *District Office*: Pittsburgh, Pa.

HP.-35-58

BIRDSBORO

STEEL FOUNDRY AND MACHINE CO.

STEEL MILL MACHINERY • HYDRAULIC PRESSES • CRUSHING MACHINERY • SPECIAL MACHINERY • STEEL CASTINGS • Weldments "CAST-WELD" Design • ROLLS: Steel, Alloy Iron, Alloy Steel

For more information fill in page number on Inquiry Card, on page 179

NEW from Standard Oil

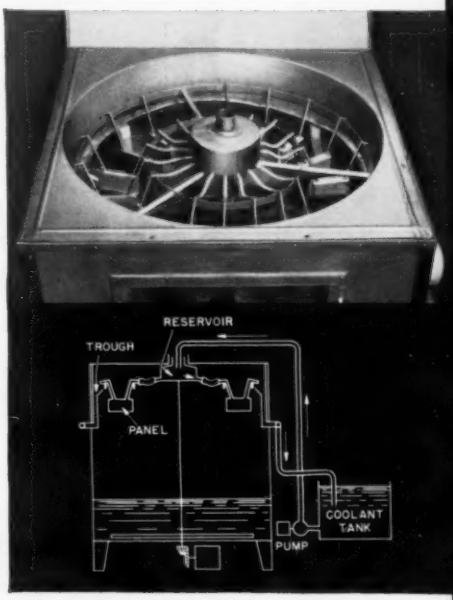
THE MAGIC BOX

Corrosion steals $5.5 billion from industry annually. Standard Oil is in the forefront of the fight to control this loss. Standard's research scientists have developed a new method for measuring the effectiveness of rust preventives. This new test takes less than one-twentieth of the time of previous tests—and is about three times as precise.

Using a controlled humidity cabinet for testing corrosion, these Standard research men installed a system for cooling metal test panels (previously treated with rust preventive) so that their surface temperatures are lower than the temperature in the cabinet. Temperatures of panel surfaces and of cabinet atmosphere are held accurately. Controlling the temperature of the panels controls the rate at which water condenses on them. This in turn (for the first time) permits accurate control of the amount of condensation on the panels. Rust preventives are more speedily and precisely tested. Science, as a result of this work, has a new tool with which to test corrosion.

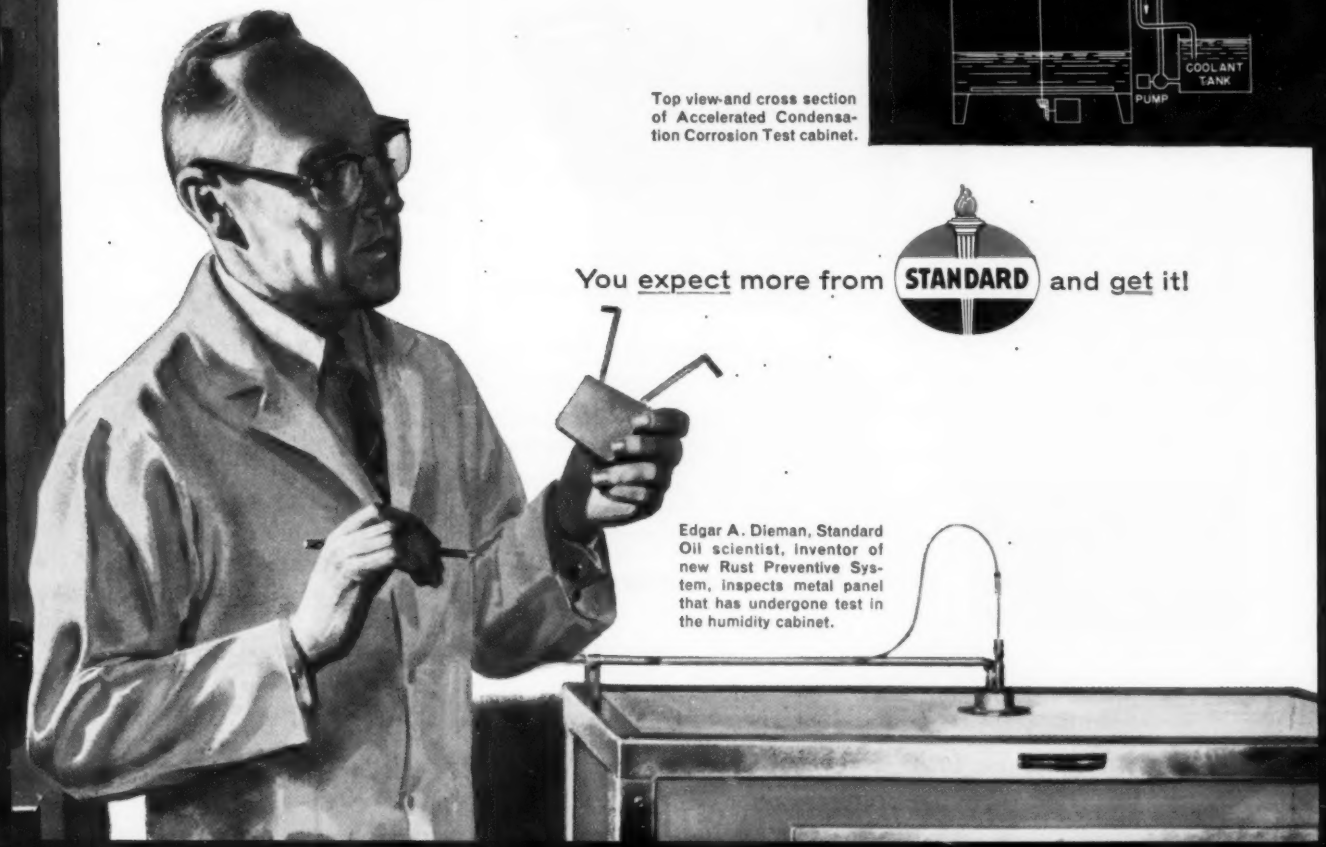
This is the research pay-out industry receives from Standard Oil. This is the something extra that backs up the Standard industrial lubrication specialist who calls on you. This is the something extra found in the products he sells.

To know more about how Standard Oil industrial lubrication specialists—and Standard's research program—can help you, call the Standard Oil office nearest you in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.**



Top view and cross section of Accelerated Condensation Corrosion Test cabinet.

You expect more from STANDARD and get it!



Edgar A. Dieman, Standard Oil scientist, inventor of new Rust Preventive System, inspects metal panel that has undergone test in the humidity cabinet.

Product Directory

To find headings easily, look for capital letters at top of each page to denote location.

ABRASIVE CLOTH, Paper and Belt
Crane Packing Co., Morton Grove, Ill.

ABRASIVES, Disc
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Gardner Machine Co., Beloit, Wis.
Norton Co., 1 New Bond St., Worcester, Mass.
Simonds Abrasive Co., Tacony and Fraley Sts., Bridesburg, Philadelphia, Pa.

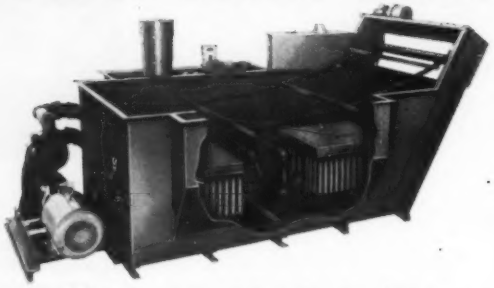
ABRASIVES, Polishing, Tumbling, Etc.
Crane Packing Co., Morton Grove, Ill.

Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony and Fraley Sts., Bridesburg, Philadelphia, Pa.

ACCUMULATORS, Hydraulic
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

For Super Finishes at Less Cost

Delpark **Dual Manifold, Vacuum Filter-Matic Filter**



Dual Manifold Tubular Screen Filter shown.

Leaf Type Filter Elements also available.

SUPER finishes no longer carry a high cost per unit. The reason is the high efficiency filtering action of the Delpark Dual Manifold Filter-Matic.

1. The rejection rate is greatly reduced.
2. Accuracy is more easily attained because of the reduced coolant temperature.
3. Machine maintenance time is reduced.
4. Filter servicing is no longer required.

Write today for the Delpark Dual Manifold Filter-Matic Filter bulletin.

Delpark —First in Filtration Advancement

INDUSTRIAL FILTRATION COMPANY
15 INDUSTRIAL AVENUE
LEBANON, INDIANA

AIR GAGES, Dimensional—See Gages Air Comparator

AIR GUNS
Chicago Pneumatic Tool Co., New York 17, N. Y.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

AIR TOOLS—See Grinders, Portable, Pneumatic—Drills, Portable, Pneumatic, Etc.

ALLOY STEELS
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Ryerson Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave., Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

ALLOYS, Bearing
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Mueller Brass Co., Port Huron, Mich.

ALLOYS, Non-ferrous—See Brass, Copper, Zinc and Stellite

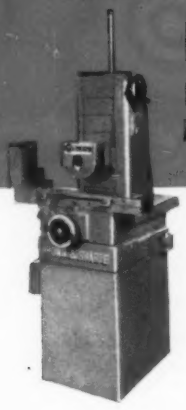
ALUMINUM and Aluminum Products
Mueller Brass Co., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson & Son, Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.

ANGLE PLATES—See Set-Up Equipment

ANNEALING FURNACES
Eisler Engrg. Co., 750 So. 13th St., Newark 3, N. J.
Holcroft & Co., 6545 Epworth Blvd., Detroit 10, Mich.

DESIGNED to meet today's toughest demands

THE NEW BROWN & SHARPE No. 510 SURFACE GRINDING MACHINE

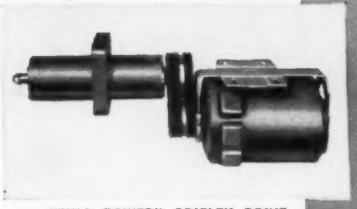


PRICED to meet today's equipment budgets

Tool and die shops, and other users of hand feed surface grinders, face increasingly tough demands today, — for high precision, for cost reduction.

The new B&S No. 510 Surface Grinder design is based on an extensive survey of these demands and needs. Add Brown & Sharpe's first-hand experience as tool manufacturing specialists, and you'll see why the new No. 510 provides the required plus in precision, work range, and efficiency.

THE LOW COST of the No. 510 is a welcome surprise to everyone who sees its many advantages demonstrated. Get details. Why settle for surface grinders of limited performance and capacity, when the same investment will buy the new No. 510? For full information, write: Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.



"FULL POWER" ORIFLEX DRIVE

LAPPED TABLE ROLLERS

"ONE SHOT" LUBRICATION

GRADUATIONS READ TO 0.0002" on the Spindle Elevating Handwheel, and on the adjustable dial of the Crossfeed Handwheel, which provides close control of transverse feed.

FULL TRAVEL TABLE OF 11" is attained by moving the Table Lever only 180°.

- **"ORIFLEX DRIVE"** to unit-type wheel spindle (left) is through five "O rings" from 1 hp motor in vibration-free mountings. The No. 510 is also available with a direct motor drive spindle.

RUGGED, CAST IRON spindle slide, upright, and table base distribute 95% of the machines' 1225 lb. weight above the heavy gage sheet steel base. Base cabinet provides liberal storage space for accessories.

- **TABLE** glides on precision ground and lapped straight rollers (left) forming 90° "V" and flat guide ways — permits easy, smooth operation and preserves precision alignment.
- **"ONE SHOT" OILER** (left) lubricates entire machine by depressing plunger.

MOVABLE SPINDLE UPRIGHT for crossfeed contributes to dependable precision slot and form grinding.

CAPACITY Grinds work 11" long, 5" wide, and 12" high with 8" dia. wheel . . . 12½" high with 7" dia. wheel.

PROGRESS IN PRECISION FOR 125 YEARS

Brown & Sharpe BS

MILLING, GRINDING, AND SCREW MACHINES • MACHINE TOOL ACCESSORIES • PRECISION TOOLS • HYDRAULIC PRODUCTS • CUTTERS

For more information fill in page number on Inquiry Card, on page 179

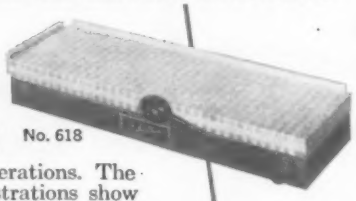
when milling costs run high . . .

After

During

Before

SWITCH TO WALKER
PERMANENT
MAGNETIC CHUCKS



No. 618

High milling costs are often caused by complicated, time-consuming set-up operations. O. S. Walker permanent magnetic chucks* are currently being used successfully for high speed gang milling operations. The "before, during and after" illustrations show how one manufacturer is saving time and money. Even at modern feeds and speeds, Walker permanent magnetic chucks hold the work securely. When the operation is completed, only a thin section of metal remains on the bottom of the work piece, making mechanical holding a difficult and complex process. Note the absence of chips on the cutter, due to automatic demagnetization.

Walker permanent magnetic chucks save you money three ways:

- Low initial cost because of the absence of expensive electrical equipment and mechanical fixtures.
- Low operating and maintenance costs.
- Low production costs because of reduced set-up time.

With Walker chucks you are sure of work flatness and parallelism because of designed-in dimensional stability assured by solid silver brazed construction. (For milling applications, a bottom plate with key slots is recommended). **Patent Applied for*

Call your machinery dealer or O. S. Walker Company, Inc., Worcester 6, Mass. . . . Start saving money today. Write for catalog.

O. S. WALKER COMPANY, INC.
WORCESTER 6, MASSACHUSETTS, U. S. A.
The Original Designers and Builders of Magnetic Chucks

ARBOR PRESSES—See Presses Arbor

ARBORS AND MANDRELS
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
Jacobs Mfg. Co., West Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Supreme Products, Inc., 2222 S. Calumet Ave., Chicago 16, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

ARC WELDERS—See Welding Equipment, Arc

ASSEMBLING MACHINES
Detroit Power Screwdriver Co., 2799 W. Fort St., Detroit 16, Mich.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit 39, Mich.
Sheffield Corp., Box 893, Dayton 1, Ohio

AUTOMATIC SCREW MACHINES—See Screw Machines, Single- and Multiple-Spindle Automatic

AUTOMATION EQUIPMENT
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Wilson Automation, P.O. Box 3855, Detroit 5, Mich.

BABBITT
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BALANCING EQUIPMENT
Gisholt Machine Co. (Static and Dynamic), 1245 E. Washington Ave., Madison 10, Wis.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mach. Tool Co., 2531 11th St., Rockford, Ill.

BALLS
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Hoover Ball & Bearing Co., Ann Arbor, Mich.

BAR MACHINES—See Screw Machines, Single- and Multiple-Spindle, Automatic

BAR STOCK, Non-ferrous
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio
Mueller Brass Co., Port Huron, Mich.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BAR STOCK AND SHAFTING, Steel
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BEARING PILLOW BLOCKS AND CARTRIDGES
Bearings, Inc., 3634 Euclid Ave., Cleveland, Ohio
Fafnir Bearing Co., New Britain, Conn.

a difficult piece to HARDEN . . .

. . . yet it gave no trouble

thanks to SAGAMORE DIE STEEL

Note the complex section of this small ratchet driven friction clutch. Yet, with non-deforming Sagamore Die Steel, there is no distortion or size variation in the intricate webbing.

After being machined from a 3" round bar of Allegheny Ludlum Sagamore, the clutch was hardened from 1775 F. The piece was air cooled and then drawn at 600 F. The result, a Rockwell C hardness of 55/56.

Sagamore is a relatively new type of non-deforming die steel which has had a rapid increase in popularity. It combines excellent non-deforming properties and unusual toughness with freedom from hardening hazards. Similar to high carbon-high chromium steels in behavior and applications, Sagamore has the added advantages of lower hardening temperatures, easier machining and grinding, greater toughness and lower costs.

There's an A-L tool steel to help solve your toughest tool steel problems. For further information, call your nearest office or distributor today, or write . . . *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

Write for your
SAGAMORE BLUE SHEET

A concise 4-page booklet of facts on the handling and shop treatments of Sagamore. Included is complete information on forging, annealing, tempering, etc. and detailed laboratory data on physical characteristics. *Ask for your free copy.*

ADDRESS DEPT. M-6

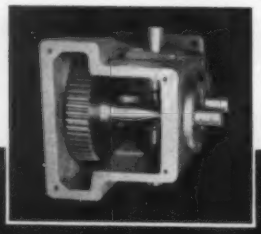
For nearest representative, consult Yellow Section of your telephone book.

For complete **MODERN** Tooling, call

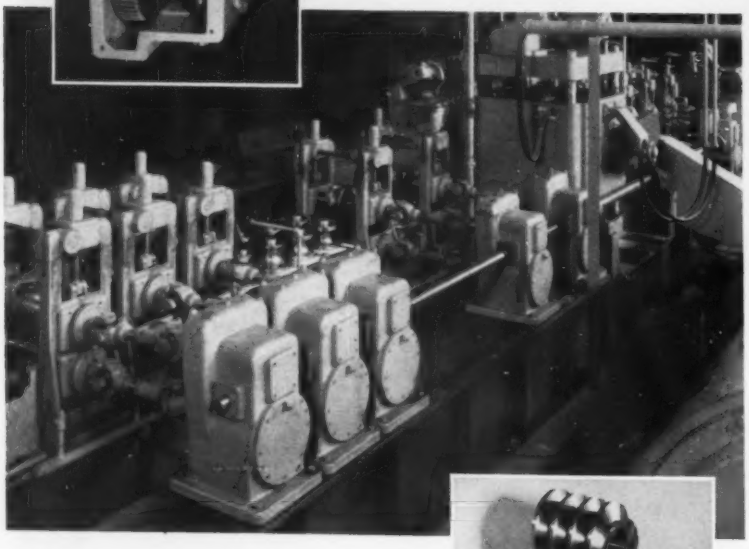
Allegheny Ludlum

WSW 6623

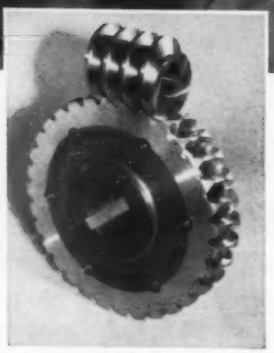
AL ® FINE TOOL STEELS SINCE 1854



Open view of drive unit shown below on machine.



Perfectly mated **H&S Worm and Gear** Sets insure smooth-running roll drives in *Abbey* **ETNA** tube mills



Worm gearing provides exceptional load-carrying capacity in compact form.

Custom-engineered mills bearing the Abbey ETNA name produce tubing and pipe around the world. Raw material passes through forming, welding, cooling, sizing and straightening processes. We're proud that Abbey ETNA selected Horsburgh & Scott precision worm and gear sets to drive the material flow regulating rolls.

H&S worm gear sets range from 3-5/9:1 to 100:1, with center distances from 3" to 30". The H&S method of generating worm gear teeth to precisely the same tooth form as their mating worm guarantees smooth conjugate action and ability to carry heavy shock loads — with long service life.

Check with H&S on *any* gear requirements — worm, helical, herringbone, spur, bevel, mitre, internal or racks. Write for your copy of H&S Gear Catalog No. 57.

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Boston Gear Works, 3200 Main St., North Quincy, Mass.
Fafnir Bearing Co., New Britain, Conn.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., 30th & Hunting Park Ave., Philadelphia, Pa.
Norma-Hoffman Bearings Corp., Stamford, Conn.

BEARINGS, Bronze and Special Alloy
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio

BEARINGS, Needle
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio

BEARINGS, Oilless
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BEARINGS, Roller
Ball & Roller Bearing Co., Danbury, Conn.
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Norma-Hoffman Bearings Corp., Stamford, Conn.
Rollway Bearings Co., Inc., 541 Seymour St., Syracuse, N. Y.
Timken Roller Bearing Co., Canton, Ohio

BEARINGS, Thrust
Ball & Roller Bearing Co., Danbury, Conn.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio
Fafnir Bearing Co., New Britain, Conn.
General Electric Co., Schenectady, N. Y.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., Nicetown, Philadelphia, Pa.
Norma-Hoffman Bearings Corp., Stamford, Conn.
Rollway Bearing Co., Inc., Syracuse, N. Y.
Timken Roller Bearing Co., Canton, Ohio

BELT SANDERS—See Grinding Machines, Abrasive Belt

BENCH CENTERS
Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BENDERS, Bar, Tube, Channel, etc.
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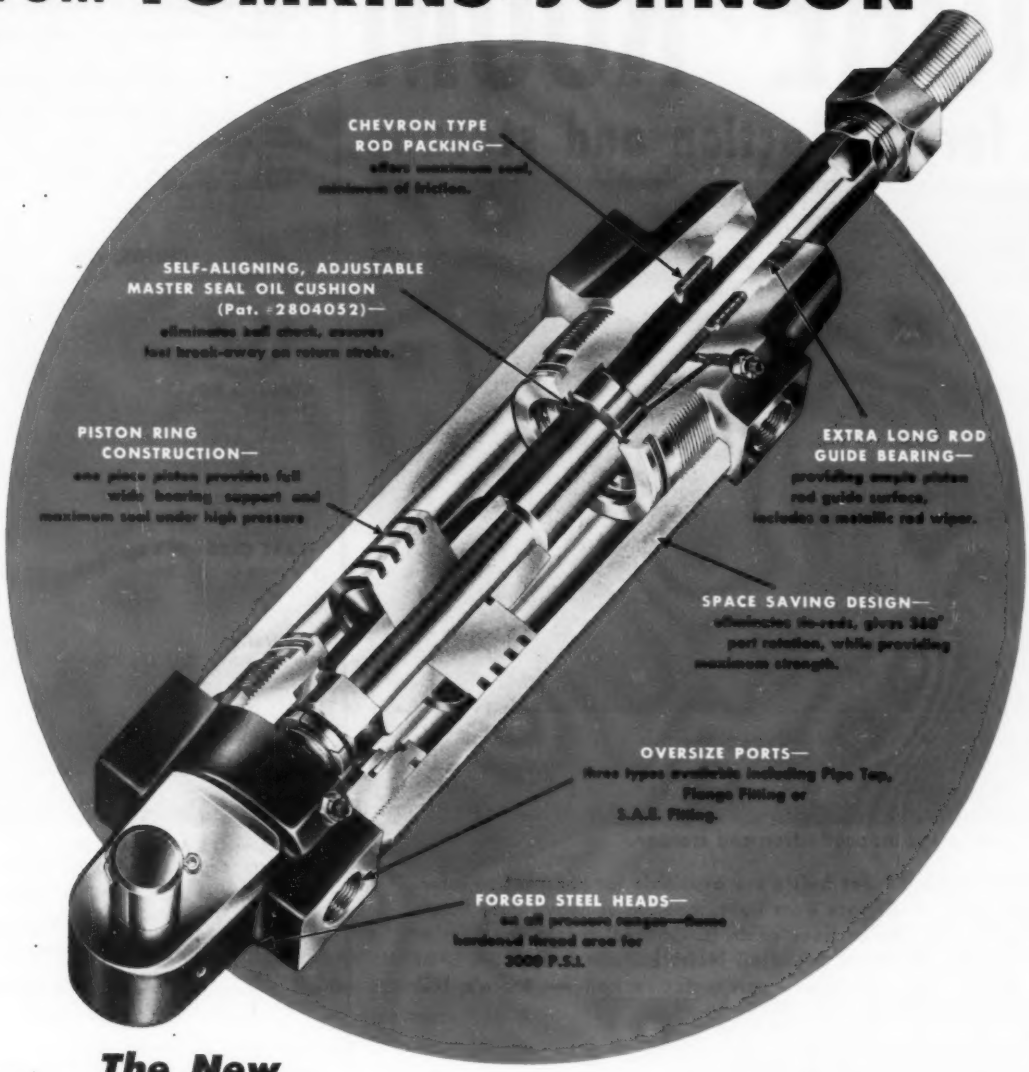
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

Another Engineering First

from TOMKINS-JOHNSON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PISTON RING CONSTRUCTION—
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FORGED STEEL HEADS—

The New T-J **Spacemaker**

HIGH PRESSURE HYDRAULIC CYLINDER

1000
● 2000 **P.S.I. Operating Pressure**
3000

Truly another engineering first from Tomkins-Johnson, the new T-J Spacemaker High Pressure Hydraulic Cylinder will provide quality power performance at high operating pressures. ONLY T-J OFFERS YOU A HYDRAULIC CYLINDER WITH ALL THESE EXTRAS—*STANDARD*, AT NO EXTRA COST. Write to The Tomkins-Johnson Company, 617 N. Mechanic Street, Jackson, Michigan, for further details and Bulletin No. HSM-5-58.

T-J **TOMKINS-JOHNSON**

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SHEPARD NILES

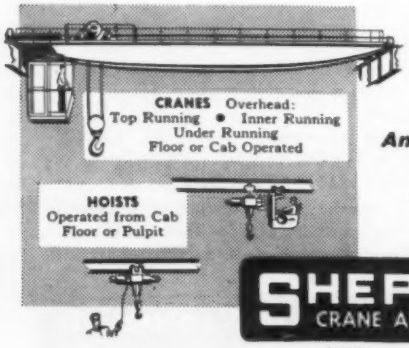
MONORAIL HOIST

MORE ROOM

. . . for production and storage

Why move materials around men, materials and machines? Use the direct route — smoothly and safely — through air. Shepard Niles Monorail Hoists and Transfer Cranes put load handling overhead . . . eliminate costly ground level handling. Use the space saved for production and storage.

Rugged Shepard Niles hoists are available for constant or intermittent service. Choose from light, medium or heavy duty hoists equipped with cab or floor controls. Offered in fast, medium or slow speeds. Send for Monorail Hoist bulletin today . . . or ask that a Shepard Niles representative call — there's NO OBLIGATION.



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America's Most Complete Line
of Cranes and Hoists
Since 1903

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Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia 42, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Chambersburg Engrg. Co., Chambersburg, Pa.
Hannifin Corp., 501 Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Engrg. Corp., Kenmore Sta., Buffalo, N. Y.
Niagara Machine & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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BLOWERS
Buffalo Forge Co., 490 Broadway, Buffalo N. Y.

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Northwestern Tools, Inc., 115 Hollier Ave., Dayton 3, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Parker-Kalon Div., Clifton, N. J.
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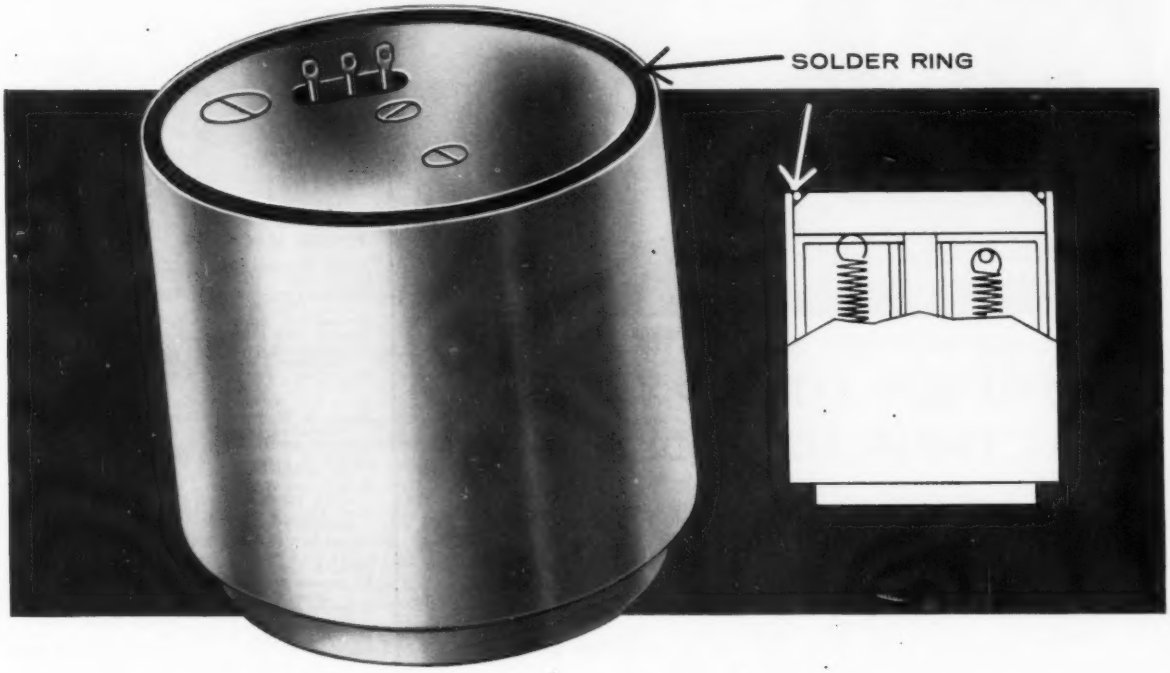
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Kennametal Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.

(Continued on page 228)

Precision soldering 7 Times Faster...

with TOCCO Induction Heating*



When G. M. Giannini and Co., Inc., Pasadena, California, switched from old-fashioned methods to TOCCO Induction Heating they increased production of these high-precision accelerometers from 4 to 30 per hour—with a commensurate *decrease* in production costs.

Here's what a Giannini official has to say about the TOCCO installation: "Prior to using TOCCO for this purpose, we had tried soldering irons, normal torches, resistance sealing, and even threaded screw fittings, with uniformly poor results. Essentially, the TOCCO unit has permitted us to build, in production quantities, oil-filled hermetically sealed units that could not be produced in any other way."

Whether your production bottleneck involves soldering, brazing, heat treating or heating for forming it pays you to investigate TOCCO as an economical way to do it better, faster and at lower cost.

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Please send copy of "Typical Results of TOCCO Induction Brazing and Soldering".

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77 SERIES—available from 1/64" to 2"

Range up to 2" at new low prices

Lufkin now provides the most complete line of radius gages . . . with a range of measurement from 1/64" up to 2". And at new low prices that make these gages a better value than ever before.

This design, pioneered by Lufkin, is preferred by toolmakers, diemakers, patternmakers and all others who make precision measurements. Each gage is a separate unit with five different gaging applications for concave and convex radii. Smooth, accurately machined gaging surfaces are polished and the faces are clearly marked as to size. Sets are packaged in durable red vinyl cases.

See your distributor about a set of Lufkin radius gages . . . the most complete range of sizes on the market. For new and improved design of all your precision tools, be sure to ask for Lufkin.

Always buy from your distributor

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TAPES • RULES • PRECISION TOOLS
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Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Bridgeport Machines, Inc., 500 Lindley St., Bridgeport 6, Conn.
Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

BORING MACHINES

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Bullard Co., Bridgeport 6, Conn.
Canton Tool Mfg. Co., E. Canton, Ohio.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis & Thompson Co., 4460 N. 24th St., Milwaukee 10, Wis.
DeVlieg Machine Co., Ferndale, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray Co., G. A., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Jones & Lamson Machine Co., Springfield, Vt.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., Lansing, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pope Machinery Co., Haverhill, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Snyder Tool & Engrg. Co., 3400 E. Lafayette St., Detroit 9, Mich.
Wales-Strippit Co., Akron, N. Y.

BORING MILLS, Horizontal

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
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Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., 450 Fair Ave., Ferndale, Detroit 20, Mich.
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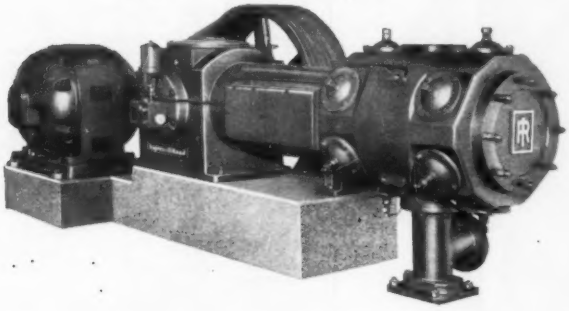
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.

(Continued on page 230)

NEW COMPRESSORS

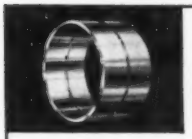
...with heavy-duty features proven in larger Ingersoll-Rand compressors

ESH* (horizontal)



ESV* (vertical)

*The same compressor in either horizontal or vertical arrangement – 20 to 150 hp sizes, single-and multi-stage, pressures up to 5000 psi and vacuums.



Full-floating aluminum bearings never need adjustment

The full-floating bearings "roll with the punch," taking each thrust on a different portion of the shell. They are foolproof, and never require fitting or adjustment. Main and crankpin bearings are made of I-R's special aluminum bearing alloy, which has higher load capacity and better heat conductivity than other bearing materials.

Air-cushioned Channel Valves give unmatched performance

Known the world over for lasting efficiency, dependability and quiet operation, Ingersoll-Rand air-cushioned Type A Channel Valves are entirely different in design and principle from any other valves in use. Type-A Channel Valves were developed especially for modern compressor speeds, and feature a separate stainless-steel seat plate which can be reversed or replaced for new life.

Never a need for adjustments– frame is kept sealed!

Here's an entirely new line of compressors, built to run longer — much longer. They're more compact, more efficient, and require less attendance, less maintenance. They offer greater capacity in less space, and are ruggedly built and highly refined to take years of continuous hard service.

All running parts are precision-machined and need no fitting or adjusting, so the frame is sealed — dirt stays out, and the major causes of wear are eliminated!

There are many design features—including filtered force-feed lubrication and full-floating self-adjusting metallic packing — that have heretofore been found only in larger Ingersoll-Rand compressors. Let your I-R representative tell you more about these new compressors, and how they can save you money.

Ingersoll-Rand

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In engineered products, there's no substitute for experience!

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

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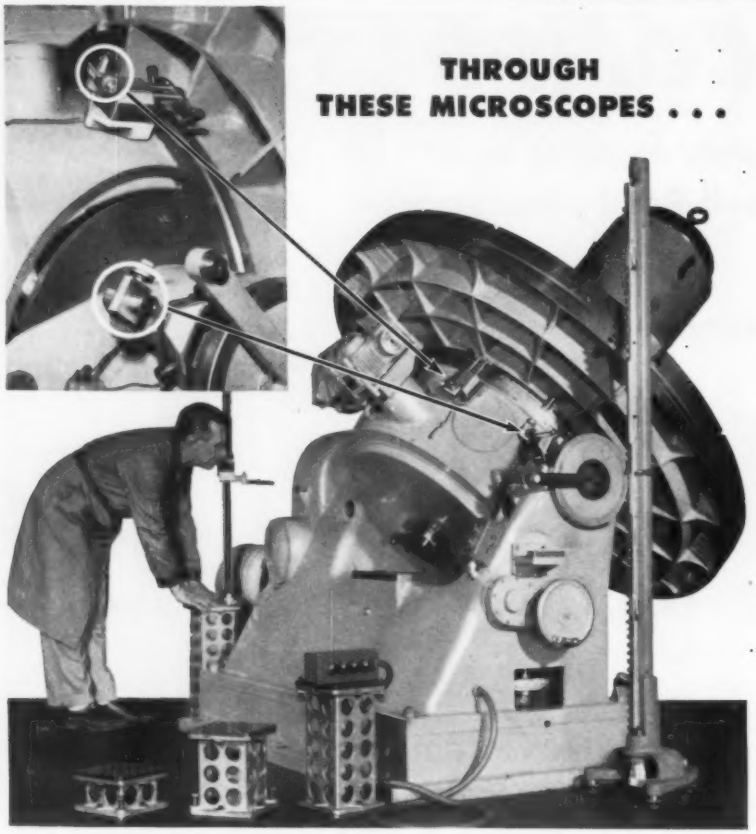

THROUGH THESE MICROSCOPES . . .

. . . POSITIONING WITH 5 SECOND ACCURACY!

Rotary table positioning with 5 second accuracy? Amazing! And when you recall that there are 1,296,000 seconds in any circle, 5 second accuracy is indeed amazing, but *true* . . . with ROTAB tiltable rotary tables. For by incorporating optical measuring systems into ROTAB design, full 360° radial positioning, 90° angular settings are easily achieved with this fine degree of precision . . . and repeat settings within one second of arc are standard procedure!

Microscopic accuracy is just one unique ROTAB feature. In addition, motor powered rotating and tilting, easy-to-use portable controls, horizontal loading vastly improve efficiency . . . to a point, in fact, where 50% savings in set-up time *alone* are not unusual. You can use ROTAB, moreover, for inspection and quality control operations or for tool room machining. In a nutshell, ROTAB gives you precision positioning, cost-cutting efficiency and a wide range of application versatility. Ask about ROTAB today!

FREE! New ROTAB catalog includes illustrations, detailed information on complete ROTAB line, from 12" to 84" faceplate sizes. A copy is yours for the asking . . . write today.

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New Britain Mch. Co., New Britain, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J
Snyder Tool & Engrg Co., 3400 E. Lafayette, Detroit 7, Mich.

BORING MILLS, Vertical

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
New Britain Mch. Co., New Britain, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.

BORING TOOLS

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Apex Tool & Cutter Co., Inc., Shelton, Conn.
Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Kennametal Inc., Latrobe, Penna
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Vascaloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

BRAKES, Press and Bending

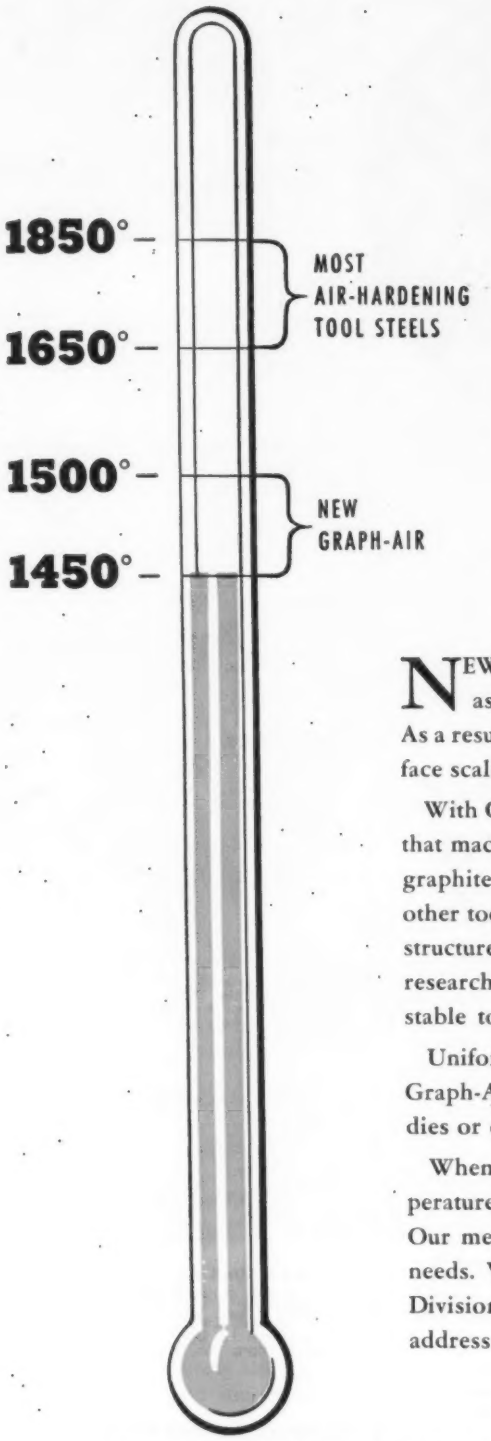
Cincinnati Shaper Co., Hopple & Gerrard, Cincinnati, Ohio.
Cleveland Crane & Engrg. Co., Wickliffe, Ohio.
Ferracute Machine Co., Bridgeport, N. J.
Lodge & Shipley Co., Hamilton 1, Ohio.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 93rd St. and S. Kenwood Ave., Chicago, Ill.

BRASS

American Brass Co., 25 Broadway, New York, N. Y.
Bridgeport Brass Co., Bridgeport, Conn.
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y.

BROACHES

American Broach & Mch. Co., Ann Arbor, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.



New Graph-Air® tool steel air-hardens from as low as 1450°F., reduces distortion

NEW Graph-Air® actually air-hardens from as low as 1450°F. That's as much as 400° lower than most other air-hardening tool steels. As a result, you reduce distortion, simplify heat treating control and surface scaling and decarburization are minimized.

With Graph-Air you get a tougher, more versatile graphitic tool steel that machines faster, wears longer, holds its accuracy longer. The free graphite in its structure makes machining easier. Graph-Air outwears other tool steels because of the uniform, diamond-hard carbides in its structure. And Graph-Air stays accurate longer—the result of painstaking research by Timken Company metallurgists, developers of the most stable tool steels ever made.

Uniform hardening and reduced distortion allow you to machine Graph-Air into more intricate sections. It's your solution for blanking dies or other steel parts that must take abuse.

When you want the best tool steel that air-hardens at the lowest temperature—specify Graph-Air. It's available in solid and hollow bar sizes. Our metallurgists will be glad to recommend the right size for your needs. Write: The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

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TRADE-MARK REG. U.S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

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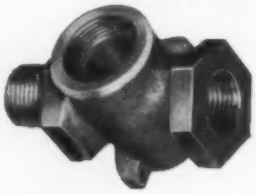
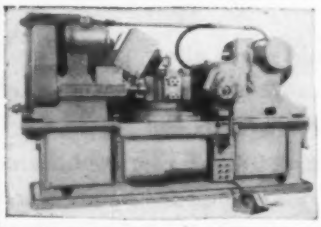
Single set-up covering
ALL finishing operations...
MEANS GREATER ACCURACY *with* **GOSS DeLEEUW**





AUTOMATIC CHUCKING MACHINES

One of the many important advantages being realized with this new chucker is the performing of ALL finishing operations on a single chucking of the work. In addition to the time saved, this feature, exclusive with Goss & De Leeuw "1-2-3" machines, means only one handling of the work with an attendant greater accuracy. This machine is in a class by itself in precision finishing.

In Goss & De Leeuw "1-2-3" Automatic Chucking Machines, one, two, or three ends of the work are machined simultaneously or in sequence. There is no need for resetting, retooling or secondary operations. More work from one machine and greater accuracy are matters of record.

Ask for illustrated literature describing the operation of this chucker in detail. Send samples of your work for time and cost estimates.

GOSS & DeLEEUW — QUALITY · PRODUCT · QUANTITY

GOSS and DE LEEUW
MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

BROACHING MACHINE, Internal
American Broach & Mch. Co., Ann Arbor, Mich.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

BROACHING MACHINE, Surface
American Broach & Mch. Co., Ann Arbor, Mich.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati, Ohio.
Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BRONZE
American Brass Co., Waterbury 20, Conn.
Bridgeport Brass Co., Bridgeport, Conn.
Mueller Brass Co., Port Huron 35, Mich.

BRUSHES, Industrial, Tampico, Wire Wheel, Etc.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, Ohio.

BUFFERS
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio.

BULLDOZERS, Metalforming
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

BURNISHING MACHINES
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

BURRING MACHINES—See Deburring Machines

BURRS—See Files and Burrs, Rotary

BUSHINGS, Drill Jig
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Hardened Steel
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Non-ferrous and Powdered Metal
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

Good, Sturdy Blanks all the way through

Fine lot of crane wheels, aren't they? Beautifully machined. They look solid and strong and dependable all the way through. And they're just as sturdy as they look, for they're made from Bethlehem forged-and-rolled blanks.

Bethlehem's unique forging and rolling process imparts soundness, high strength, and excellent grain flow. It makes the machinist's job easier, less costly; the forgings have no hidden flaws to snag and slow the cutting tool.

For making circular steel parts, our forging and rolling process simply can't be surpassed. Bethlehem blanks are widely used in the making of heavy-duty gears, crane and sheave wheels, turbine rotors, flywheels, pipe flanges, and many other circular products. Available in either carbon or alloy steel, they can be furnished in a wide choice of sections and in sizes from 10 to 46 in. OD.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
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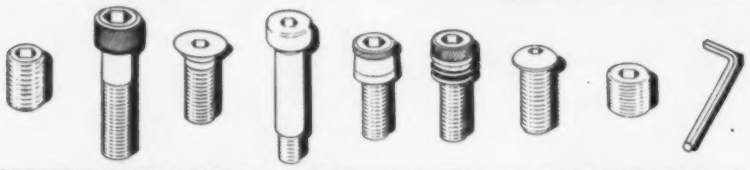
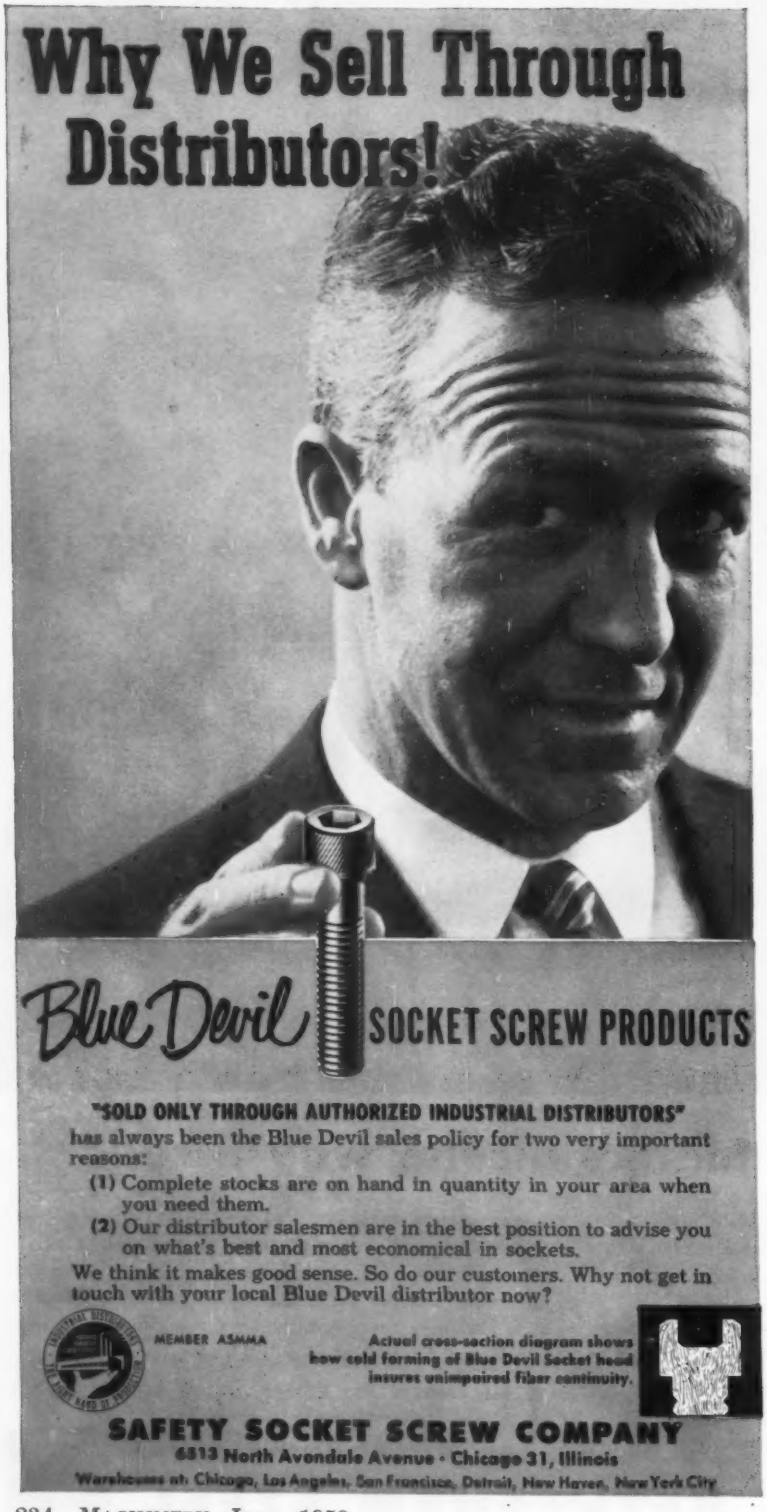
BETHLEHEM STEEL

BETHLEHEM STEEL

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"SOLD ONLY THROUGH AUTHORIZED INDUSTRIAL DISTRIBUTORS"
has always been the Blue Devil sales policy for two very important reasons:
(1) Complete stocks are on hand in quantity in your area when you need them.
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CALIPERS, Spring, Firm-Joint, Transfer, Hermaphrodite, etc.—See Layout and Drafting Tools, Machinists' Small Tools

CALIPER, Vernier

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S. Co., Athol, Mass.

CAM CUTTING MACHINES

Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Van Norman Mch. Co., 3640 Main St., Springfield 7, Mass.

CAM MILLING AND GRINDING MACHINES

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Pa.
Rowbottom Machine Co., Waterbury, Conn.

CAMS

Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 S. 13th, Newark 3, N. J.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Rowbottom Machine Co., Waterbury, Conn.

CARBIDES

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CASTINGS, Die

American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio.
Mueller Brass Co., Port Huron 35, Mich.
Pittsburgh Brass Mfg. Co., 3199 Penn Ave., Pittsburgh 1, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

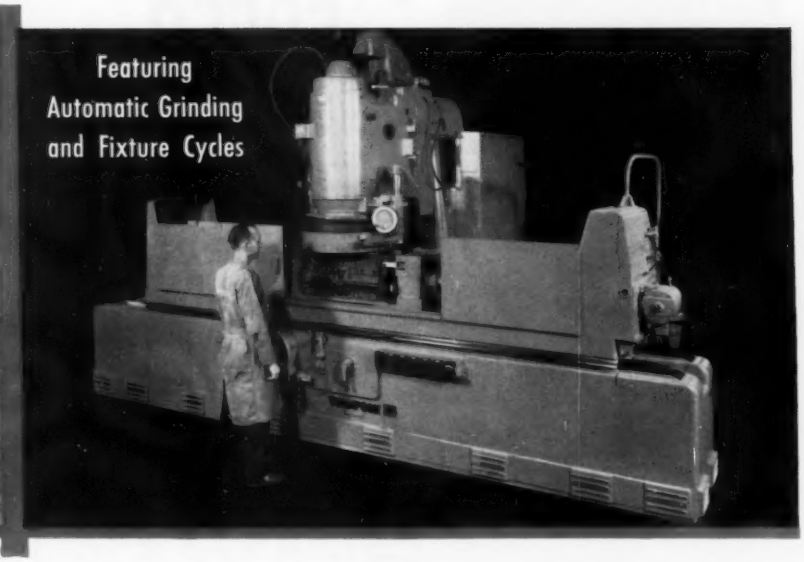
CASTINGS—Gray Iron, Malleable

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Centrifugally Cast Products Div.—Shenango Furnace Co., Dover, Ohio.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

THOMPSON handles the toughest production jobs... *fast and accurately...*

with

THE VERTICAL SPINDLE SURFACE GRINDER



SPECIFICATIONS

Size: 18" x 18" x 62"
Wheel: 22" Segmental
Production: 30 blocks per hour
Total Stock Removal: .010"

Shown above is the latest Thompson vertical spindle machine grinding the diesel engine cylinder blocks of a leading truck manufacturer. To meet the demand for fast, continuous production, both the fixture and grinding cycles are automatic and are interlocked to prevent accident. A separate hydraulic power source operates the single place fixture which locates the cylinder block on the main bearing holes.

Since any variations in stock removal would affect the compression ratio of the engines, constant accuracy is controlled throughout the grinding cycle. The operator merely sets wheel contact with the work and automatic operation begins.

Thompson vertical spindle surface grinders are made in various types and sizes to meet all job requirements. All machines of 40 inches and up in work length are equipped with the Hydra-Cool Hydraulic System*—the exclusive Thompson feature that eliminates all heat distortion throughout the machine.

*Pat. Applied For

MACHINE CYCLE (Total Stock Removal .010")

CYCLE I

1. Load work piece into fixture and start table cycle.
2. * Manually lower grinding wheel to contact work piece.
3. Automatic downfeed of wheel occurs at each table reverse to remove .010" stock.
4. Spark out to final size with table moving to start position.
5. * Manually elevate grinding wheel to starting position and release work piece in fixture.
6. Table automatically stops.

**Can be furnished as automatic functions.*

For more information fill in page number on Inquiry Card, on page 179

Thompson SURFACE GRINDERS

THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO

"Keep Thompson in mind for that daily grind"

HIGH SPEED FORGING

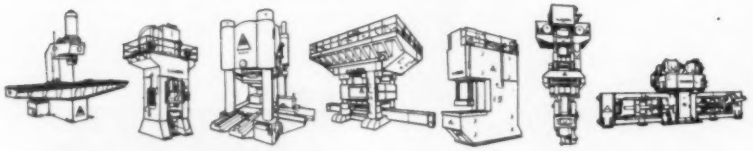
with a CLEARING Hydraulic

High speed forging? Exactly. We're talking about presses especially designed for high speed flat die forging – Clearing Hydraulics. These presses with exclusive control systems that provide planishing stroke rates from 60 to 100 SPM are available in capacities from 300 to 5,000 tons and up.

If you are working with these metals:

Zirconium • Stainless • Titanium
Alloy Aluminum • Uranium,

we can help you increase manufacturing efficiency. Call on a Clearing engineer to discuss your problem.



Do Clearing hydraulic presses like these fit into your manufacturing plans? Call or write for Clearing Hydraulic Press Catalog. No obligation.

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the way to efficient mass production

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CASTINGS, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.

CEMENT, Abrasive Disc
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Walls Sales Corp., 333 Nassau Ave., Brooklyn 22, N. Y.

CENTER-DRILLING MACHINES
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Improved Machinery, Inc., Nashua, N. H.
La Salle Tool Inc., 3840 E. Outer Drive, Detroit 34, Mich.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CENTER PUNCHES — See Machinists' Small Tools

CENTERS, Grinding Machines, Indexing Head and Lathe
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Houston Grinding & Mfg. Co., Inc., Houston 8, Texas
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

CERAMIC TOOL MATERIAL—See Tool Material, Ceramic

CHAINS, Power Transmission and Conveyor
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.

CHUCKING MACHINES, Multiple-Spindle Automatic
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Cone Automatic Mch. Co., Inc., Windsor, Vt.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., 2729 Lyons Ave., Lansing, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKING MACHINES, Single-Spindle Automatic
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Potter and Johnston Co., 1027 Newport Ave., Pawtucket, R. I.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio.

CHUCKS, Air Operated

Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Cushman Chuck Co., Windsor Ave., Hartford 2, Conn.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Collet

Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Cushman Chuck Co., 800 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Errington Mech. Lab. Inc., 24 Norwood Ave., Staten Island 4, N. Y.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

CHUCKS, Combination Universal-Independent

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Compensating

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Drill, Key Type

Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Jacobs Mfg. Co., West Hartford, Conn.

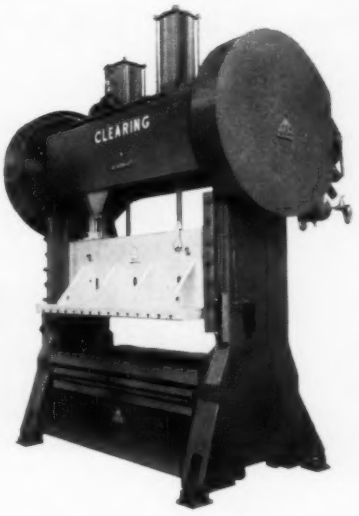
CHUCKS, Drill, Keyless

Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Jacobs Mfg. Co., West Hartford, Conn.

(Continued on page 238)

What You Should Know About

Press Capacity



A leading producer of home appliances is using the press above to good advantage. Clearing Series-S presses combine the precision of a straight side machine with a basically economical design.

This manufacturer can schedule a number of jobs for his machine—regardless of die height—and *know* he has the available press tonnage for each job.

Clearing provides a means for determining tonnage at *all* points of the stroke. A chart in the Clearing Series-S catalog shows press capacity which will be a helpful guide for determining capacity for all forming operations.

Write for your free copy.

HI-SPEED FOR SPECIAL JOBS?

SEE CLEARING

Clearing's line of Hi-Speed presses can be adapted to many special jobs. Here's one that's supplying a large home appliance manufacturer with metal dryer baskets.

A special control and special feeding equipment, automatically pierce thousands of holes in precisely positioned rows. An automatic Hi-Speed press like this can relieve you of many problems and speed up your manufacturing process, too.

For detailed information on Hi-Speed Presses, Write Clearing.

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- ☐ Plunger Guiding
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- ☐ Series-S Crankshaft Straight Side
- ☐ O.B.I.
- ☐ Bottom Drive
- ☐ Hydraulic
- ☐ Brochure—"New Economics of Press Automation"

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the way to efficient mass production

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when the pressure's on . . . it's

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HYDRAULIC PUMPS

for constant displacement . . .

HYDRAMITE

- Pressures to 5,000 psi
- Capacities of 3, 5, 10 gpm and up
- No supercharging needed
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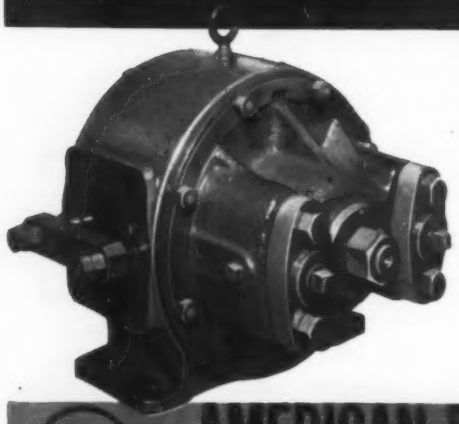
- Either rotation for direct drive

for variable displacement . . .

HELE-SHAW



- Instantly reversible
- From 0 to 3,000 psi
- Capacities from 3 to 110 gpm
- Infinitely variable discharge
- Many types of controls

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CANADIAN SUBSIDIARIES: Affiliated Engineering Corporations, Ltd. Montreal, P. Q. . . . Brandon Industries Ltd., Toronto, Ont.

CHUCKS, Full Floating

Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Gisholt Mch. Co., Madison 10, Wis.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Gear

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Supreme Products, Inc., 2222 S. Calumet Ave., Chicago 16, Ill.

CHUCKS, Independent

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Lathes, etc.

Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Bullard Co., Brewster St., Bridgeport 2, Conn.
Cushman Chuck Co., Windsor Ave., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Horton Chuck, Windsor Locks, Conn.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Magnetic

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Hanchett Magna-Lock Corp., Big Rapids, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Walker, O. S., Inc., Worcester, Mass.

CHUCKS, Power Operated

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Quick Change and Safety

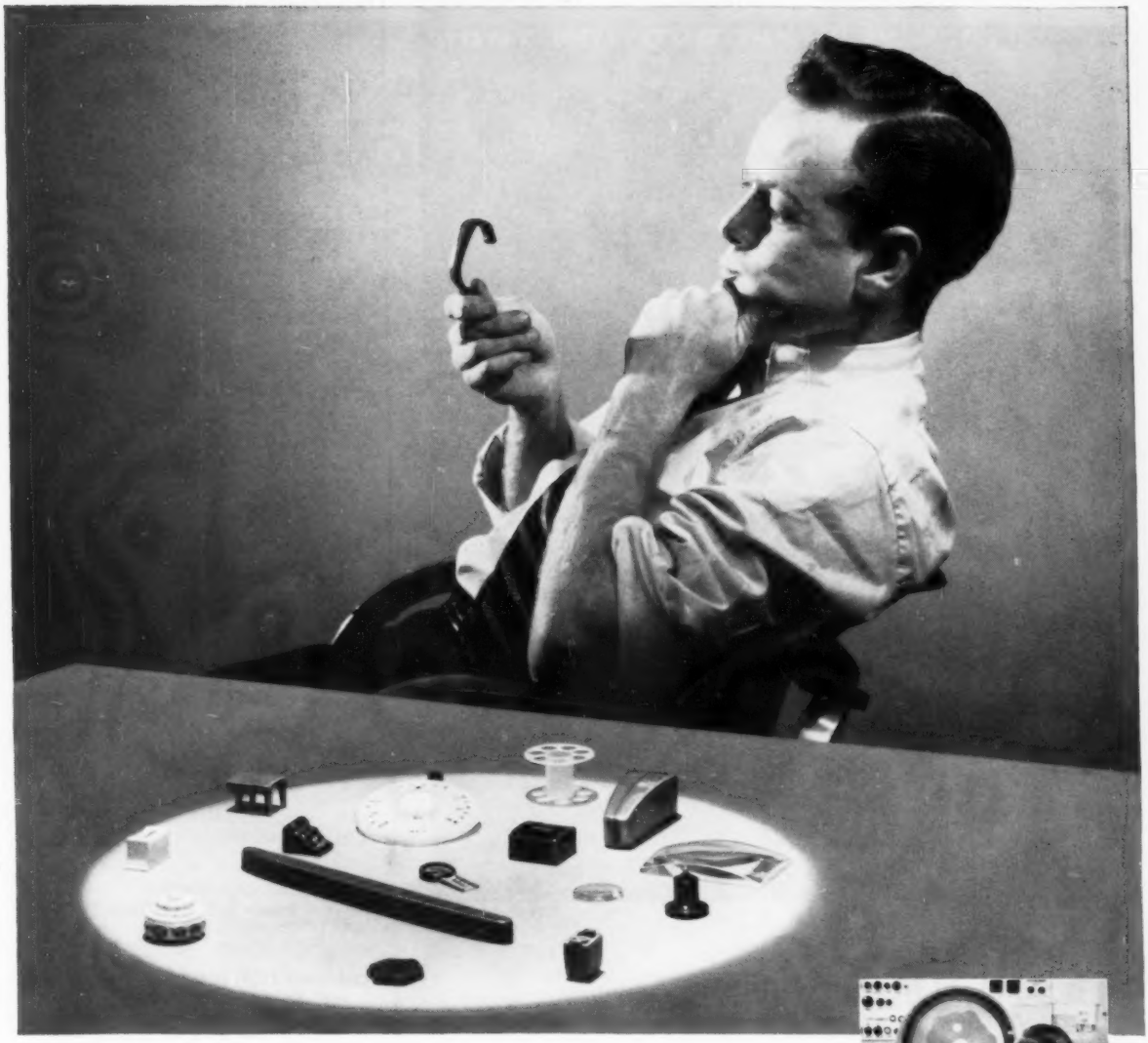
Jacobs Mfg. Co., West Hartford 10, Conn.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Universal Engineering Co., Frankenmuth 2, Mich.

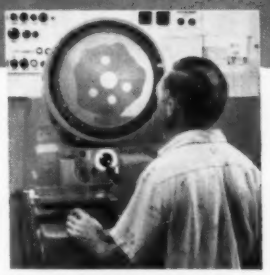
CHUCKS, Ring Wheel

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, Tapping

DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Jacobs Mfg. Co., West Hartford, Conn.





With this Kodak Contour Projector Auburn Plastics, Inc., accurately gages a great variety of parts down to .001". Operator can easily measure angular dimensions on cams and keys, threaded mold components, center-to-center dimensions on parts and tools.

How many gages to inspect these parts?

Just one—if it's a Kodak Contour Projector.

Auburn Plastics, Inc., of Auburn, N. Y., a venerable custom molder, produces a wide variety of component parts for various manufacturers. Formerly this firm needed many mechanical gages to make necessary quality control checks.

A *Kodak Contour Projector* eliminated the expense of buying such gages—amounting in *one instance to a saving* of *$5,000*.

In a fiercely competitive business, Auburn Plastics, Inc., can submit *lower* bids because of savings permitted by *optical gaging*. The company effects additional economies by using its Kodak Contour Projector to inspect *tools* and *dies* as well as manufactured components. In all cases the projector permits gaging of angles, radii, holes and other dimensions—at a glance.

If you have an inspection problem involving myriad small parts, you can do the job easily and inexpensively with a Kodak Contour Projector. Inspection is a matter of comparing the projected image of the part with a chart gage on the screen. You inspect different types of parts simply by changing chart gages. Operators need little training.

For additional information or to arrange for a demonstration of any of the 6 Kodak Contour Projector models, write to:

Apparatus and Optical Division

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

the KODAK CONTOUR PROJECTOR

Kodak
TRADE MARK

For more information fill in page number on Inquiry Card, on page 179

A NEW PRODUCTION TOOL

BAIRD 8" 4-spindle

VERTICAL CONTINUOUS LATHE

offering timely
cost reduction possibilities

Combines productive capacity of four lathes in one compact unit.
Not an indexing machine. Continuous operation saves
indexing time. "Wide open" tooling areas permit great
flexibility in tooling on each spindle.
Can handle work in wide range of sizes, interchangeably or "mixed."
Minimum floor space required.
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Designed and built for long-run maintenance economy.

For further information, write Dept. M.

THE BAIRD MACHINE COMPANY
STRATFORD • CONNECTICUT

BAIRD Six and Eight Spindle Chuckers • Automatic Multiple Transfer Presses • Automatic 12 Station Duplex Turning Machines • Vertical Continuous Lathes • Automatic Four Slide Machines • Pneudraomatic Ribbon Metal Forming Machines • Barrel Finishing Machinery • Machinery for Chain and Roller Chain Production, Garment Hook and Eye Production • Precision Bench Presses

2BA58

Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.

CHUCKS, Universal Three-Jaw
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Gisholt Mch. Co., Madison 10, Wis.
Horton Chuck, Windsor Locks, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Wrenchless
Gisholt Mch. Co., Madison 10, Wis.

CIRCUIT-BREAKERS
General Electric Co., Schenectady 5, N. Y.

CLAMPS, "C", Toggle, Toolmakers' Parallel—See Set-Up Equipment

CLEANERS, Metal
Oakite Products, Inc., 19 Rector St., New York, N. Y.

CLUTCHES
Cleveland Punch & Shear Works, Co., 3917 St. Clair Ave., Cleveland 14, Ohio.
Dynamatic Div. Eaton Mfg. Co., Kenosha, Wis.
Minster Mch. Co., Minster, Ohio.
Rockford Clutch Div., Rockford, Ill.

COLD HEADING
Hassall, John, Inc., Westbury, L. I., N. Y.
National Machinery Co., Tiffin, Ohio

COLLETS—See Chucks, Collet

COLLOIDAL GRAPHITE
Acheson Colloids Co., 2150 Washington Ave. Port Huron, Mich.

COMBINATION SQUARES—See Machinists' Small Tools

COMPARATORS, Dial, Electronic and Air
DoAll Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 883, Dayton 1, Ohio.
Starrett, L. S., Co., Athol, Mass.

COMPARATORS, Optical
Bausch & Lomb Optical Co., Rochester, N. Y.
DoAll Co., 54 Laurel Ave., Des Plaines, Ill.
Eastman Kodak Co., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Opta-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 1, N. Y.

COMPOUNDS, Cleaning—See Cleaners, Metal

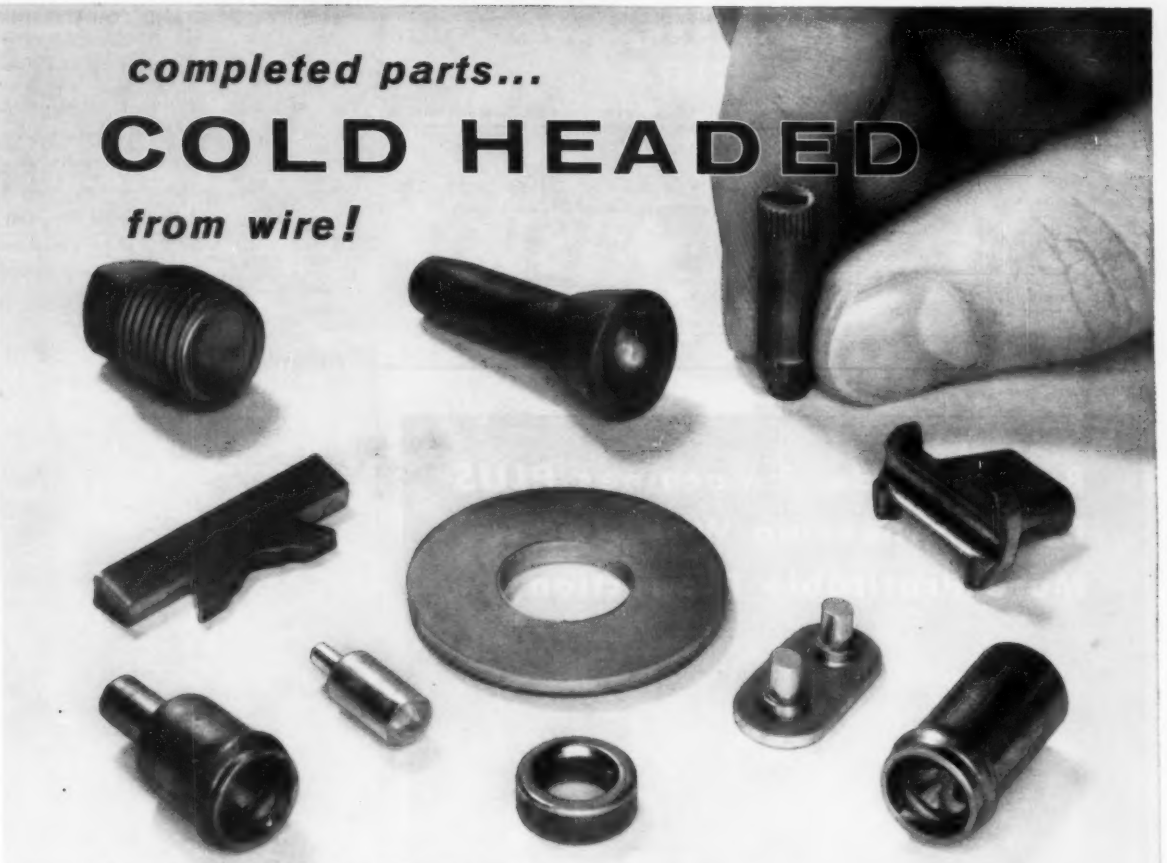
COMPOUNDS, Cutting, Grinding, Metal Drawing, etc.—See Cutting and Grinding Fluids

COMPRESSORS, Air
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

completed parts...

COLD HEADED

from wire!



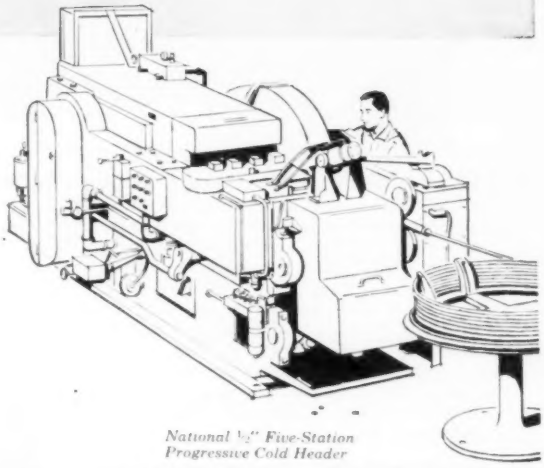
Top row, left to right: pipe plug, ball seat for push-rod end, splined square-head shaft. Middle row: commutator bar, solenoid contact, wire clamp. Bottom row: distributor cap insert, transistor case, spacer, link, distributor cap center wire insert.

All of the odd-shaped metal parts above were developed for fast, accurate production on National Cold Headers.

Complete and ready to use, these parts are made from wire, start-to-finish in one compact machine, at unbelievably high speeds with excellent die life, in most cases with no loss of material!

Production ranges from 40 parts per minute with stock of 1½" diameter up to 450 per minute in the ⅛" size. The jobs illustrated average 161 per minute.

Have you investigated Cold Heading? If you now have headers, have you considered widening your range and type of work to meet the growing requirements of metalworking?



National ½" Five-Station Progressive Cold Header

Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

HARTFORD DETROIT CHICAGO

For more information fill in page number on Inquiry Card, on page 179

CONTOUR FOLLOWER—See Tracing Attachments

CONTRACT WORK

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Bliss, E. C., Co., 1375 Raff Rd., S. D., Canton, Ohio.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Eisler Engrg. Co., 750 S. 13th St., Newark 3, N. J.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Van Keuren Co., Watertown, Mass.

CONTROLLERS

Allen-Bradley Co., 1331 S 1st St., Milwaukee, Wis.

CONTROL SHAFTS—See Lead-screws & Splines, Ball Bearing

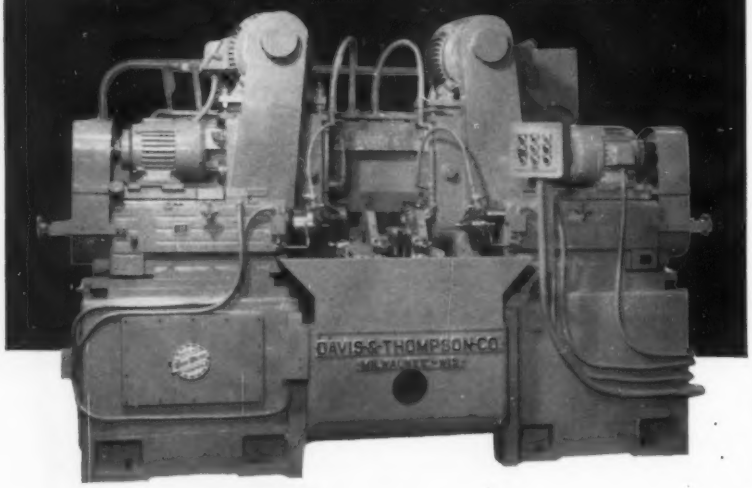
CONVEYORS FOR DUST, CHIPS, ETC.

Barnes, W. F. & John Co., Rockford, Ill.

COPPER

American Brass Co., 25 Broadway, New York, N. Y.
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

Basic Standard Machines *PLUS* D&T Engineering Will Give You More Profitable Production . . .



HERE'S WHY: Although this machine has been adapted to milling and centering of small shafts, its basic design lends itself to other operations through the addition of various types of heads as well as multiple spindle drill heads.

Feeds and speeds are variable. The hydraulically operated machine table is equipped with an air-operated fixture which is electrically controlled for either automatic or mechanical cycling.

If you need production with a minimum capital outlay, it will pay you to call in a D & T production engineer. There is no obligation for this service.

ADDITIONAL INFORMATION

For more examples of outstanding production machine tools, write for Bulletin 1002.

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Davis and Thompson Co.

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COUNTERBORES AND COUNTERSINKS

Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 120 Oakman Blvd., Detroit 32, Mich.
Haynes Stellite Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

COUNTERS

Starrett, The L. S., Co., Athol, Mass.

COUPLINGS

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
Mueller Brass Co., Port Huron, Mich.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Walker Co., Inc., O. S., Rockdale St., Worcester, Mass.

CRANES, Electric Traveling

Cleveland Crane & Engrg. Co., Wickliffe, Ohio.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

CUTTERS, Keyseating

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
DoAll Co., Des Plaines, Ill.
du Mont Corp., Greenfield, Mass.
Mitts & Merrill, 1009 So. Water St., Saginaw Mich.
National Twist Drill & Tl. Co., Rochester,
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

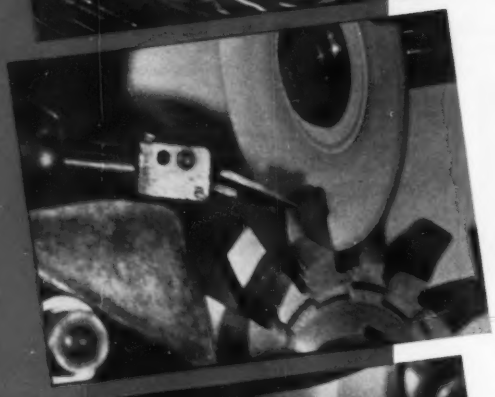
CUTTERS, Milling

Apex Tool & Cutter Co., Inc., Shelton, Conn.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gorton, George, Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National Milwaukee 14, Wis.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.
National Twist Drill Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Tomkins-Johnson Co., Jackson, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CUTTING AND GRINDING FLUIDS

Cincinnati Milling Products Div., Cincinnati, Ohio.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio.
Cities Service Oil Co., 70 Pine St., New York, N. Y.
DoAll Co., Des Plaines, Ill.
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Sinclair Refining Co., 600 Fifth Ave., New York, N. Y.

(*Continued on page 244*)



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ABRASIVE CO.

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SA Borolon®
TRADE MARK

GRINDING WHEELS

"WE LIKE THEIR COOL CUTTING ACTION"

"CORNERS HOLD UP WELL"

"NO OTHER WHEELS RUN SO TRUE"

Superior grinding! That's the theme of these unsolicited quotes from users of Simonds SA Borolon wheels—and an indication of the efficient job these wheels are doing in toolrooms throughout industry. Their superiority is due to the single, uncrushed crystal formation of SA Borolon — enabling this unique aluminum oxide abrasive to present an uninterrupted sequence of sharp cutting edges, free from stress.

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Send for bulletin ESA 272 for details, together with grain and grade specifications.

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Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia, Pa.
Texas Co., 135 E. 42nd St., New York, N. Y.

CUTTING-OFF MACHINES, Lathe Type
Bardons & Oliver, Inc., 1133 West Ninth St., Cleveland 13, Ohio.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Cone Automatic Mch. Co., Windsor, Vt.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Modern Machine Tool Co., Jackson, Mich.

CUTTING-OFF SAWS, Abrasive Wheel
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Pa.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

CUTTING TOOLS—See Tool Material

CYLINDERS, Air
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Hannifin Co., 509 S. Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Tomkins-Johnson Co., Jackson, Mich.

CYLINDERS, Hydraulic
Barnes, John S., Corp., 301 S. Water St., Rockford, Ill.
Chicago Pneumatic Tool Co., New York 17, N. Y.
Hannifin Co., 509 S. Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Machine Co., Inc., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers, Inc., Detroit 32, Mich.
Wilson, K. R., Inc., Arcade, N. Y.

DEBURRING MACHINES
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

DEMAGNETIZERS
Blanchard Mch. Co., 64 State St., Cambridge, Mass.
Lufkin Rule Co., Saginaw, Mich.

DIE CASTINGS—See Casting, Die

DIE CASTING MACHINES
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Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

DIE CUSHIONS
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Mch. Corp., 6499 W. 65th St., Chicago, Ill.
Federal Machine & Welder Co., Overland Ave., Warren, Ohio
Minster Mch. Co., Minster, Ohio.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.

DIE INSERTS, Carbide
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

DIE SETS AND DIEMAKERS' SUPPLIES
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Producto Mch. Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.
Wales-Strippit Co., Akron, N. Y.

DIE SINKING MACHINES—See Milling Machines, Die Sinking, etc.

DIE STOCKS—See Stocks and Dies

DIES, Blanking, Forming, Drawing, Extruding, etc.
Cincinnati Shaper Co., Hopple & Garrard, Cincinnati, Ohio
Ferracute Mch. Co., Bridgeton, N. J.
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Olofsson Corp., Lansing, Mich.
Ryerson & Son, Inc., Jos. T., 16th & Rockwell St., Chicago 8, Ill.
Utz, Georg, Zurich, Switzerland
Vascoloy-Ramet Corp., Waukegan, Ill.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.
Wales-Strippit Corp., North Tonawanda, N. Y.

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CUTS LIKE THIS IN SECONDS!

And you can do it in your own shop for lowest ultimate cost

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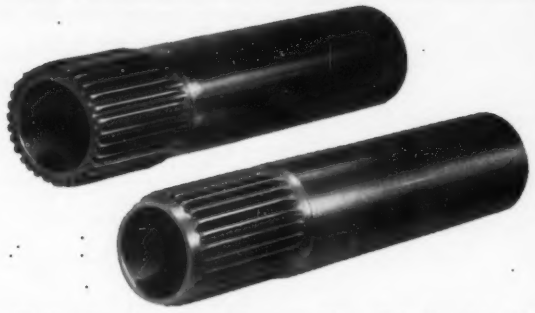
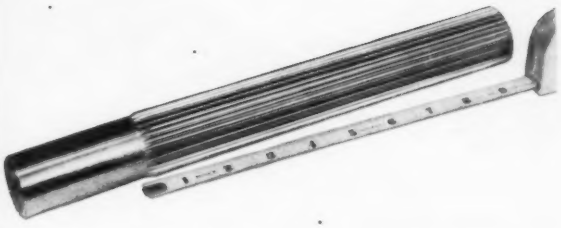


Tubular parts—*On even thin-walled tubes from ½ to 2-inches OD, splines and serrations can now be quickly and inexpensively Roto-Flo cold formed.*



Long splines—*can now be cold rolled on solid as well as tubular parts. 30° or 45° PA tooth forms can be made with this low-pressure method and axially fed parts.*

Announcing a NEW ROTO-FLO METHOD

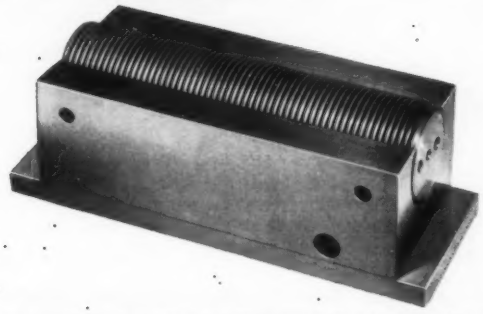
Now the **ROTO-FLO** chipless process that cold forms toothed parts faster at lower cost is extended to a broader range of parts. The development complements present Roto-Flo equipment.
Write for details!

–for spline rolling tubular parts

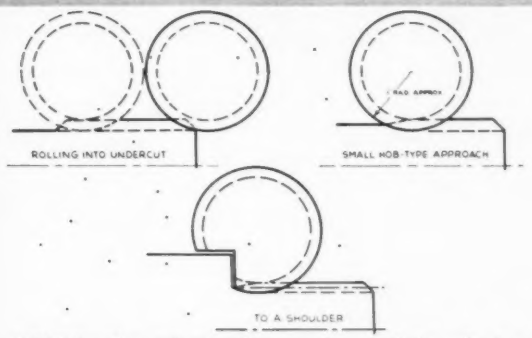
–for splines of any length

–with versatile lower cost tooling

–economical for shorter runs



Lower-cost tooling—*Cylindrical forming racks reciprocate in opposed directions while a part is fed in axially. Racks are indexable to several settings for long life and lower tool inventories. No regrind costs are involved with these throwaway forming inserts.*



All kinds of parts—*are inexpensively splined or serrated with this versatile new Roto-Flo method. Notched racks can form full-depth teeth within ¼ inch of a shoulder. Parts having the same pitch diameter can be rolled with the same rack.*

May we have the Roto-Flo field engineer in your area show you how this new method can make your parts better.

MICHIGAN TOOL COMPANY

7171 E. McNICHOLS RD., DETROIT 12, MICH., U.S.A.
IN CANADA: COLONIAL TOOL CO. LTD.

For more information fill in page number on Inquiry Card, on page 179

DIES, Lettering and Embossing
Wales-Strippit Corp., North Tonawanda, N. Y.

DIES, Self-opening Threading
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio

DIES, Thread Cutting—See Stocks and Dies

DIES, Thread Rolling
Landis Machine Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

DISINTEGRATORS
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Elox Corp., Royal Oak 3, Mich.

DIVIDERS AND TRAMMELS—See Layout and Drafting Tools

DIVIDING HEADS—See Indexing and Spacing Equipment

DOWEL PINS
Allen Mfg. Co., 133 Sheldon St., Hardford 2, Conn.
DoAll Co., Des Plaines, Ill.
Producto Machine Co., 985 Housatonic Ave., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.

DRAWING COMPOUNDS
Oakite Products, Inc., 26 Rector St., New York 6
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.

DRESSERS, Grinding Wheel
Colonial Broach & Machine Co., P. O. Box 37, Harper St., Detroit 13, Mich.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.
Norton Co., 1 New Bond St., Worcester, Mass.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

DRIFT KEYS
DoAll Co., Des Plaines, Ill.

DRILL HEADS, Multiple Spindle
Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Buffalo Forge Co., Broadway, Buffalo, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Hartford Special Machinery Co., 387 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Leland Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Richmond, Ind.
Snyder Tool & Engrg. Co., 3400 Lafayette, Detroit 7, Mich.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
United States Drill Head Co., 616 Burns, Cincinnati, Ohio
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

DRILL HEADS, Unit Type
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Kingsbury Mch. Tool Corp., Keene, N. H.
Snow Manufacturing Co., Bellwood, Illinois

DRILL SLEEVES AND EXTENSION HOLDERS
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Automatic Tool Co., Richmond, Ind.
National Twist & Tool Co., Rochester, Mich.

DRILLING ATTACHMENTS, Multiple Spindle—See Drill Heads, Multiple Spindle, and Vises, Machine

DRILLING AND BORING UNITS, Self-contained
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Buhr Machine Tool Co., 839 Green St., Ann Arbor, Mich.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., S. 7th and N. Sts., Richmond, Ind.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit, Mich.
Townsend, H. P. Mfg. Co., Elmwood, Conn.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

DRILLING MACHINES, Automatic
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Edlund Mchry. Co. Div., Cortland, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Olofsson Corp., Lansing, Mich.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Secrest Machine Co., Washington, D. C.
Snow Manufacturing Co., Bellwood, Ill.
Townsend H. P., Mfg. Co., Elmwood, Conn.
Wales-Strippit Corp., Akron, N. Y.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

DRILLING MACHINES, Bench
Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester, Mass.

DRILLING MACHINES, Deep Hole
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Wales-Strippit Corp., Akron, N. Y.

DRILLING MACHINES, Gang, Multiple-spindle
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 4460 124th St., Milwaukee 10, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Greenlee Bros. & Co., 136 12th St., Rockford, Ill.
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.

(Continued on page 248)

If **WEAR** *is a factor...*

...use VK CARBIDE PLUG GAGES

TUNGSTEN CARBIDE
wire type .010" to .760" diameter*

TUNGSTEN CARBIDE
taper lock type .365" to 1.510" diameter

In addition to its regular line of tungsten carbide wire type plug gages from .010" to .760" diameter, The Van Keuren Co. now offers a line of tungsten carbide taper lock plug gages in the range from .365" to 1.510" diameter.

Van Keuren tungsten carbide wire type gages have proved their worth on thousands of tough gaging jobs. VK tungsten carbide taper lock gages are similarly effective. If wear is a factor in your overall gage costs, you can save money by using VK carbide plug gages.

Finish on VK gages in either the wire type or taper lock type in tungsten carbide will average .5 RMS or better.

These gages are available in Class Y, X, XX, and XXX accuracies at moderate prices and on a reasonable delivery basis.

*Note full length wire-type member in above illustration.

Send for a copy of the new, 258-page Van Keuren Catalog and Handbook No. 36 containing valuable technical and engineering information on measuring problems and methods. Address:

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THE Van Keuren CO.,

178 WALTHAM STREET, WATERTOWN, MASS.

39th YEAR

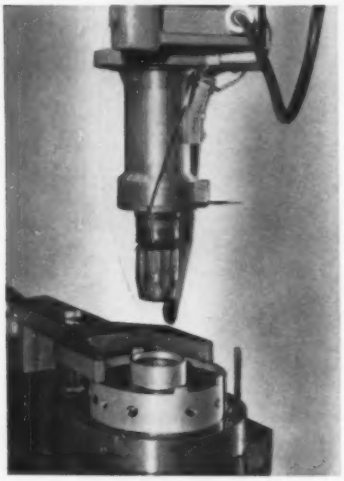
Optical Flats . . . Light Wave Equipment . . . Light Wave Micrometers . . .
Gage Blocks . . . Wire Type, Taperlock and Trilock Plug Gages . . . Master
Setting Disks . . . Thread Measuring Wires . . . Gear Measuring Wires . . .
Carbide Plug Gages . . . Carbide Pivots . . . Precision Lapping Service.

For more information fill in page number on Inquiry Card, on page 179

Why MICROHONING

Provides Lower Cost— Consistent Accuracy—Maximum Production

Success of modern mass production invariably depends on complete interchangeability of parts. Thus, processing procedures that provide consistent accuracy at high production rates are required—Microhoning machines having automatic Microsize gaging assure "all parts are created equal" at a faster rate and at lower cost.



The variety of work piece and processing factors that influence automatic sizing are too diversified to be encompassed by a single gaging technique. Thousands of Microhoning applications have verified this fact. Therefore, through its continuing program of research and development, Micromatic has designed several automatic gaging devices—each provides advantages for specific types of use. Typical of features to be found in Microsize controls are the following two examples:

EXPANDING GAGE MICROSIZE

1 Gage wear held to a minimum—gage enters work collapsed.
2 Fine size adjustment through a range of .010" on diam.
3 Geometric accuracy—free-floating tool and/or part.
4 Diametric accuracy—.0003" or less.
5 No limit on maximum bore diameter to be gaged.

GAGE RING MICROSIZE

1 Simple to operate and maintain.
2 Geometric accuracy—free-floating tool and/or part.
3 Diametric accuracy—.0003" or less.
4 Gages bores from .120" to 4" diam.
5 Only honing tool enters bore—nothing to mar finish of soft surfaces.

The real answer to efficient automatic gaging is found in applying the right gaging technique to each job—it is here that Micromatic "know-how" can be of vital service to you.

Learn why Microhoning will give efficient stock removal, closer tolerances, accurate alignment and functional surfaces.

☐ Please have a Micromatic Field Engineer call.
☐ Please send Micromatic literature and case histories.

NAME_____
TITLE_____
COMPANY_____
STREET_____
CITY_____ ZONE_____ STATE_____ K

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN

Leland-Gifford Co., Box 989, Worcester, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

DRILLING MACHINES, Radial

American Tool Works Co., Pearl and Eggleston Ave., Cincinnati, Ohio
Carlton Mch. Tool Co., 2961 Meeker St., Cincinnati 25, Ohio
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio
Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

DRILLING MACHINES, Sensitive

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland 8, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Henry & Wright Div., Hartford, Conn.
Leland-Gifford Co.; Box 989, Worcester, Mass.
Levin & Son, Inc., Louis, 3610 So. Broadway, Los Angeles, Calif.
National Automatic Tool Co., Inc., S. 7th and N. St. Richmond, Ind.
Snow Manufacturing Co., Bellwood, Illinois
Townsend, H. P., Mfg. Co., Elmwood, Conn.
Wales-Strippit Corp., Akron, N. Y.

DRILLING MACHINES, Universal Radial

Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.

DRILLING MACHINES, Upright

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes, W. F. & John Co., Rockford, Ill.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Canton Tool Mfg. Co., E. Canton, Ohio
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Lathe & Tool Co., Marburg, Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York, 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
Rehnberg-Jacobson Mfg. Co., 2135 Kishwaukee St., Rockford, Ill.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit Corp., Akron, N. Y.

DRILLS, Center
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

DRILLS, Core
Ace Drill Corp., Adrian, Mich.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Twist Drill & Tl. Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

DRILLS, Deep Hole, Gun
Ace Drill Corp., Adrian, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass:
National Twist Drill & Tl. Co., Rochester, Mich.

DRILLS, Oil Hole, Oil Tube
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.

DRILLS, Portable Electric
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

DRILLS, Portable Pneumatic
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

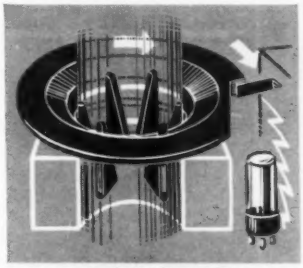
DRILLS, Ratchet
Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

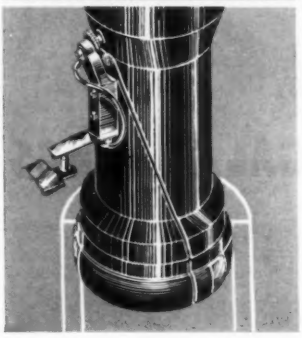
DRILLS, Subland
Ace Drill Corp., Adrian, Mich.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.

How MICROHONING
Provides Lower Cost— Consistent Accuracy—Maximum Production

Inherent characteristics of the Microhoning process are: rapid stock removal —generation of geometric and dimensional accuracy—ability to produce any desired functional surface finish. By using automatic Microsize controls, Microhoning's economies for precision processing can be fully utilized.

Today, there are several different types of automatic Microsize gages. The type best suited for individual applications can only be determined by considering the workpiece and processing factors. How automatic cycling of Microhoning machines is accomplished by using Microsize gages is indicated by the following typical examples:





GAGE RING MICROSIZE

The gage ring, which is mounted above the workpiece, has an I.D. equal to required bore diameter. When bore has been Microhoned to size, plastic tabs on the abrasive sticks contact I.D. of gage ring causing it to turn. This movement triggers an air switch or an electronic pickup to initiate the ending of Microhoning cycle. Production-proved diametric accuracy on bores from .120" to 4" in diameter is .0003" or less.

EXPANDING GAGE MICROSIZE

This gage reciprocates in synchronization with the Microhoning tool but is not attached to it. Entering the bore on every downstroke of the tool, the gage expands only at the bottom of each stroke. When gage expands to required bore diameter, two preset electrical contacts meet and initiate the ending of Microhoning cycle. There is no limit on maximum bore diameter that can be gaged—diametric accuracy held to .0003" or less.

To most efficiently meet each automatic sizing requirement, Micromatic employs a wealth of experience in the use of air, liquid, electronic and mechanical controls.

☐ Please send me your movie "Progress in Precision" in time for showing on _____ (date).
☐ Please have a Micromatic Field Engineer call.
☐ Please send Microhoning literature and case histories.

NAME _____
TITLE _____
COMPANY _____
STREET _____
CITY _____ ZONE _____ STATE _____ K

MICROMATIC HONE CORP.
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WHATEVER the inside or outside pressures, Shenango centrifugal castings are better able to withstand them without failure.

Parts cast by the Shenango centrifugal process are much tougher because their finer, *pressure-dense* grain avoids stress concentrations while providing greater strength, better elongation and freedom from such costly defects as sand inclusions, blowholes and such.

Whether you need rings, rolls, sleeves, liners, bushings, bearings, mandrels or *any* annular or symmetrical part . . . ferrous or non-ferrous . . . in whatever shape, size or dimension to meet your requirements . . . Shenango can do the job. And do the job *better!*

For informative bulletins on the answers to your tough problems, it will pay you to write now to: *Centrifugally Cast Products Division,* The Shenango Furnace Company, Dover, O.

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COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE METAL • ALLOY IRONS

DRILLS, Twist, High-Speed Steel, Carbon Steel

Ace Drill Corp., Adrian, Mich.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Twist, Carbide, Carbide-tipped

Ace Drill Corp., Adrian, Mich.
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Wire

Ace Drill Corp., Adrian, Michigan
Cleveland Twist Drill Co., Cleveland, O.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

DUPLICATING ATTACHMENTS — See

DUST COLLECTORS AND CONTROL SYSTEMS

Brown & Sharpe Mfg. Co., Providence, R. I.
Pangborn Corp., Hagerstown, Md.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 14, Ohio

ELECTRICAL DISCHARGE MACHINES
—See Disintegrators

ELECTRONIC CONTROL SYSTEMS

Electronic Control Systems, 2231 S. Barrington Ave., Los Angeles 64, Calif.

ELECTROPLATING EQUIPMENT

Wagner Brothers, Inc., 433 Midland Ave., Detroit 3, Mich.

ENGRAVING MACHINES

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mach., 1321 Racine St., Racine, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

EXPANDERS, Mechanical, Hydraulic

Grotnes Machine Wks., Inc., 5454 N. Walcott, Chicago 40, Illinois

For Longer Life . . .
Less Kerf . . . Best Non-Ferrous Cutting

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This Simonds solid saw (new to the market) has already made a *solid* hit! The men who have to get the work out are sold on the Simonds "Hard Rim's" longer cutting life between sharpenings . . . the better finish it imparts to the non-ferrous metals and plastics it cuts so smoothly . . . the minimum kerf as against non-solid saw cutting. Yes and everyone likes the Simonds "Hard Rim" because of its non-shattering safety when run at high speeds and the protective advantages to personnel.

This very true cutting saw is available in diameters of 8″ to 18″. Try it out — call your Simonds Distributor!

QUICK FACTS

Saw Rim — Made very hard for unparalleled resistance to abrasion and wear

Saw Body — Made just hard enough to keep the saw cutting straight

Resharpening — Easily done on standard saw grinding equipment

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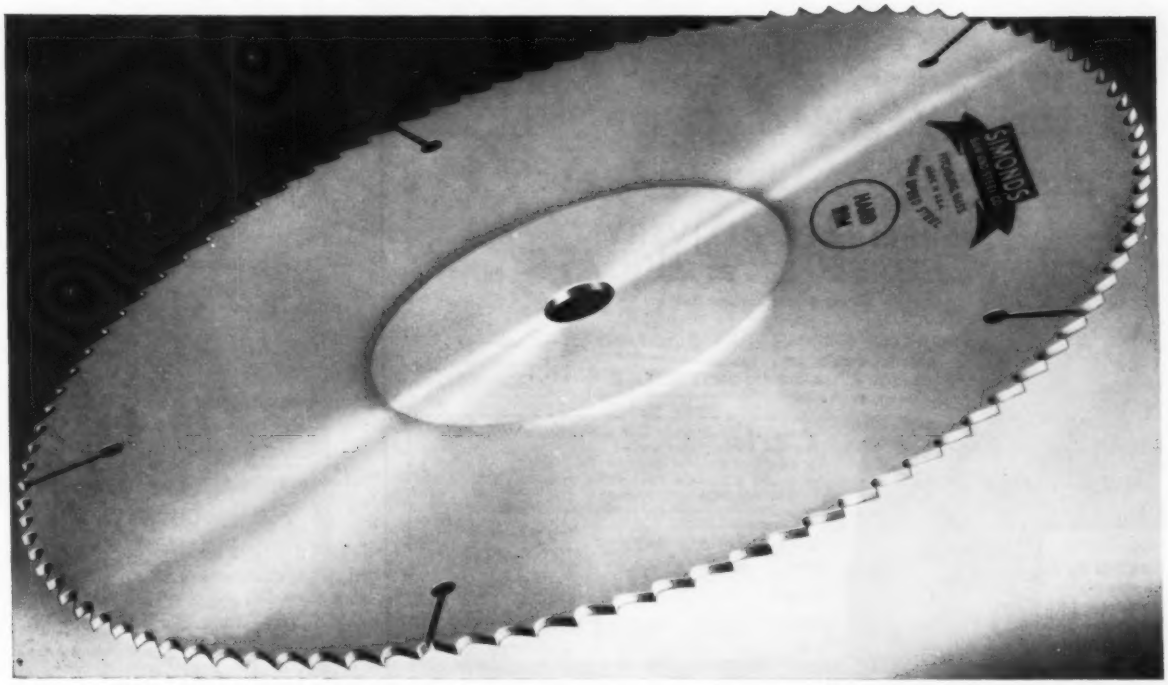
Heller Tool Co., Newcomerstown, Ohio, Simonds Abrasive Co., Phila., Pa., and Arvida, Que., Canada



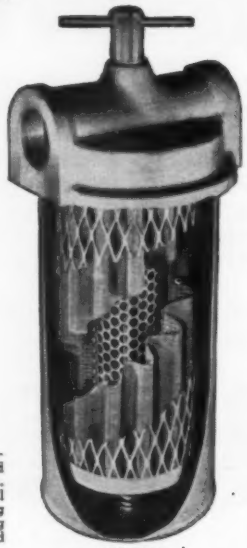
MARVEL Synclinal FILTERS

SUMP TYPE (cutaway)

For Efficient Filtration of—

Hydraulic Oils – Fire Resistant Hydraulic Fluids – Coolants – Lubricants – Water

OVER 800
Original Equipment Manufacturers Install Marvel Synclinal Filters as Standard Equipment



LINE TYPE (cutaway)

PROTECT EQUIPMENT
INCREASE PRODUCTION
REDUCE MAINTENANCE

Marvel Synclinal Filters installed in the sump or on the line preceding pump offer maximum protection on all hydraulically actuated and other equipment utilizing low pressure circulating oil systems. Maintenance and production costs are reduced because Marvel Synclinal Filters BALANCED design offers greater ACTIVE filtering area with sufficient storage capacity for filtered out damaging particles, thus, longer periods of productive operation are attained at minimum "down time" due to maintenance and repairs.

PRODUCTION ENGINEERS and MAINTENANCE MEN whose job it is to keep production machinery operating at peak efficiency and who have recognized the superiority of Marvel Synclinal Filters in the filtration of hydraulic oils, fire resistant hydraulic fluids, coolants, lubricants, etc. are specifying Marvel Synclinal Filters on all new equipment and standardizing with Marvel Synclinal Filters on all machines within their plants.

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G.P.M. Greater capacities may be attained by multiple installation (as described in catalog). Choice of monel mesh sizes range from coarse 30 to fine 200.

EASY TO CLEAN

Both sump and line types are easily disassembled, thoroughly cleaned and reassembled, on the spot, in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

IMMEDIATE DELIVERY!

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Catalogs containing complete data available on request

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- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name .....
Company .....
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City .....
State MY-6

EXTRACTORS, Screw
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.

FACING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis Boring Tool Div. Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Mummert-Dixon Co., Hanover, Pa.

FANS, Exhaust, Ventilating
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

FASTENERS
Allen Mfg. Co., 133 Sheldon St., Hartford 2, Conn.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Hassall, John Inc., Westbury, L. I., N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

FEEDERS, Automatic
Gear-O-Mation Div., Michigan Tool Co., 7171 McNichols Rd., Detroit 12, Mich.
V & O Press Co., Hudson, New York

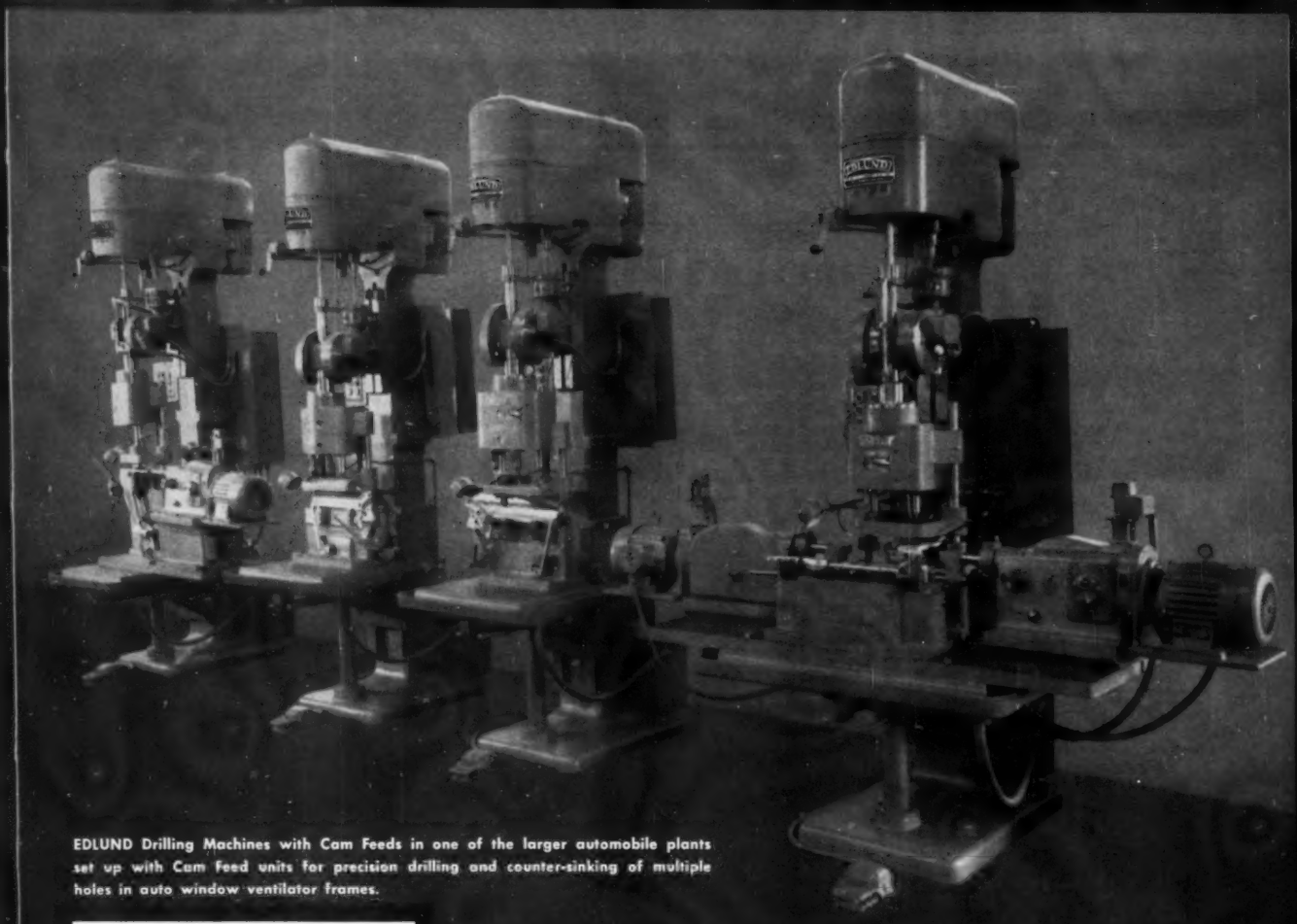
FILES, Band
DoAll Co., Des Plaines, Ill.

FILES, General-purpose, Swiss Pattern
DoAll Co., Des Plaines, Ill.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.

FILES AND BURRS, Rotary
DoAll Co., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

FILING MACHINES
Chicago Pneumatic Tool Co., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

FILTERS, Coolant and Oil
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Industrial Filtration Co., 15 Industrial Ave., Lebanon, Ind.
Marvel Engineering Co., 7227 N. Hamlin Ave., Chicago 45, Ill.



EDLUND Drilling Machines with Cam Feeds in one of the larger automobile plants set up with Cam Feed units for precision drilling and counter-sinking of multiple holes in auto window ventilator frames.

Close up of auto window ventilator frame showing multiple holes drilled and countersunk in different planes all accurately located in quantity production.

CALL EDLUND — DRILLING SPECIALISTS

EDLUND

MODEL F DRILLING MACHINES

Cam Feeds Combined With Cam Feed Units for

ACCURATE PRODUCTION DRILLING OPERATIONS

Difficult drilling of angular holes and holes in different planes to the main machining operation is readily done with the versatile EDLUND MODEL F machine equipped with Cam Feed attachment and with Cam Feed units for secondary operations mounted on the table of the drilling machine. Pay-off is faster production drilling, reaming, tapping, spot facing, counter boring, and counter-sinking with single tools or multiple drill heads.

The standard Edlund Cam Feed machine with infinitely variable speeds gives economical versatility and can be readily set-up for different, high or low, production jobs by means of easily replaced low cost cams.

Call the Edlund Drilling Specialist for assistance in meeting your special needs for low cost efficient drilling.

• Infinitely Variable Speed • Motor Spindle • V-Belt • Gun-Type • Special

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EDLUND MACHINERY CO.

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PRECISION
BALANCE
with Heavy-Duty
ONE PIECE SHAFT

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INSURES LONGER... TROUBLE-FREE LIFE

PROLONGS BEARING LIFE

THE INSIDE STORY

The shaft and rotating assembly of all Gusher Coolant Pumps is electronically balanced, precision built to reduce vibration to an absolute minimum. You get reduced wear, a longer . . . trouble-free life for your Gusher Pumps.

Gusher Coolant Pumps also give you split-second coolant flow from the moment the machine is turned on. There is no priming needed.

Maintenance effort is at a minimum too. Heavy-duty pre-lubricated ball bearings require no further attention. There is no packing needed—no seals requiring replacement. Specify Gusher Pumps on your machines. Write today for catalog and price list.

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• CIRCULATORS • AGITATORS
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Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Gleason Works, 100 University Ave., Rochester 3, N. Y.

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Chambersburg Engrg. Co., Chambersburg, Pa.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

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Ajax Mfg. Co., 1441 Chardon Rd., Cleveland 17, Ohio
Bliss, E. W. Co., 1375 Raff Rd. S. W., Canton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
National Machinery Co., Tiffin, Ohio

FORGINGS, Drop
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Wyman-Gordon Co., Worcester, Mass.

FORGING, Hollow-Bored
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron, Mich.

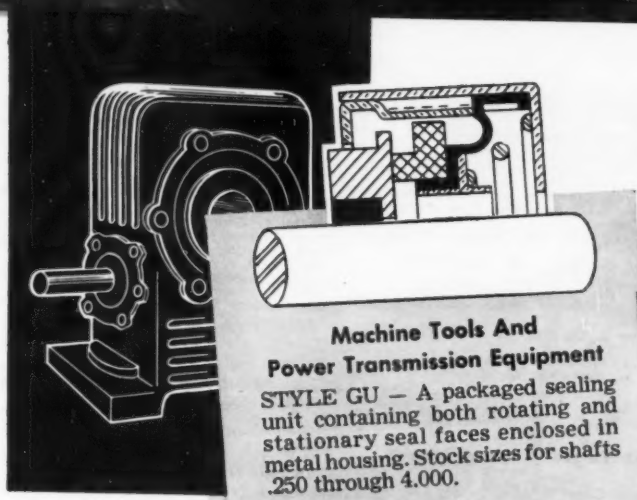
FORGINGS, Press
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Minster Mch. Co., Minster, Ohio
Mueller Brass Co., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y. (die-pressed)
U. S. Steel Corp., Pittsburgh, Pa.

FORGINGS, Upset
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.

FORMING MACHINES, Cold-rolling
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Niagara Mch. & Tool Works, 637 Northland Ave., Buffalo, N. Y.
Yoder Co., 5500 Walworth, Cleveland, Ohio

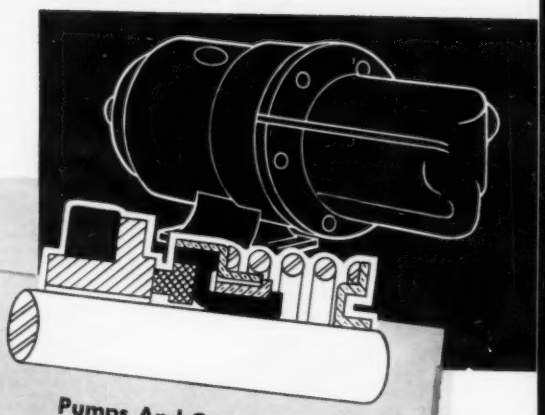
FORMING MACHINES, Multiple-slide
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Baldwin-Lima-Hamilton Corp., Lima-Hamilton Div., Hamilton, Ohio
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engrg. Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65 St., Chicago 38, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Dreis & Krump Mfg. Co., 7416 Loomis Blvd., Chicago 36, Ill.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North Main St., Ampere, N. J.

For more information fill in page number on Inquiry Card, on page 179



Machine Tools And Power Transmission Equipment

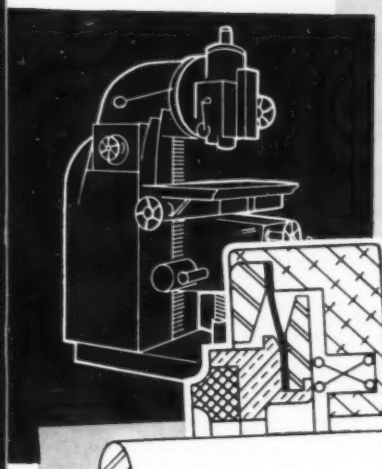
STYLE GU — A packaged sealing unit containing both rotating and stationary seal faces enclosed in metal housing. Stock sizes for shafts .250 through 4.000.



Pumps And Compressors

ROTO-FLEX — Rugged flexibility. Only 3 parts. Single or double units. Stock sizes for shafts .250 through 4.000.

STYLE RFO — A specially designed Roto-flex seal, for installation outside the stuffing box. Stock sizes for shafts .250 through 4.000.



Heavy Machine Tools

STYLE DPC — A high-speed, carbon-faced seal, for more compact installation in heavy industrial machinery. Stock sizes for shafts .250 through 4.000.

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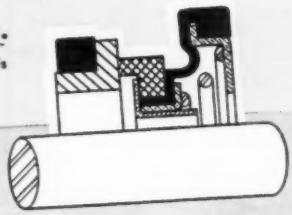
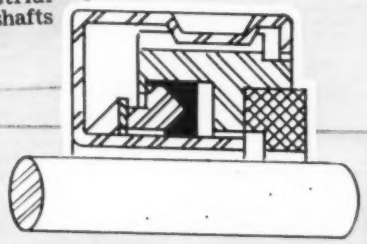


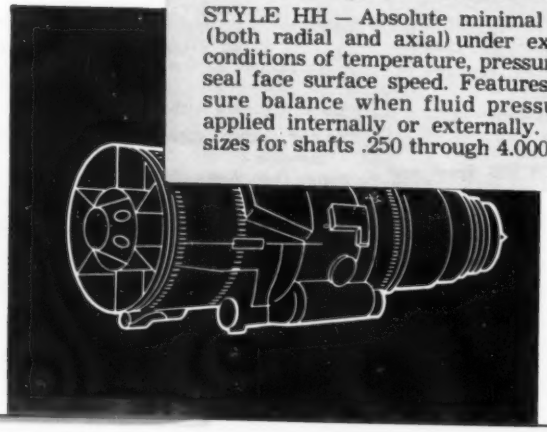
Household Appliances

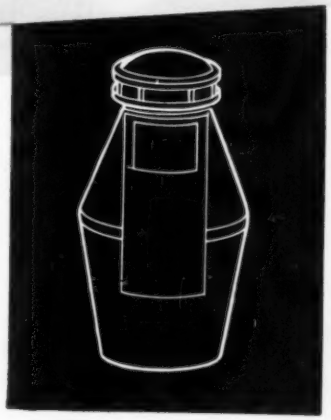
STYLE SGU—A factory-assembled unit-type seal for the small-budget user. Stock sizes for shafts .250 through 1.000.



Aircraft Engines And Accessories

STYLE HH — Absolute minimal space (both radial and axial) under extreme conditions of temperature, pressure and seal face surface speed. Features pressure balance when fluid pressure is applied internally or externally. Stock sizes for shafts .250 through 4.000.





FORMING TOOLS or Tool Blanks
Brown & Sharpe Mfg. Co., Providence, R. I.
Haynes Stellite Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York
Kennametal, Inc., Latrobe, Pa.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

GAGE BLOCKS
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES, Air Comparator
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Size Control Co., 2500 W. Washington Blvd Chicago 12, Ill.

GAGES, Automatic Sorting
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, DIAL, Bore, Height, Depth, Thread, Groove, etc.
Ames, B. C., Co., Waltham 54, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Comtor Co., 47 Farwell St., Waltham 54, Mass.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Lufkin Rule Co., Saginaw, Mich.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Size Control Co., 2500 W. Washington Blvd Chicago 12, Ill.
Starrett, The L. S., Co., Athol, Mass.

GAGES Electric Comparator
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio
Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.

GAGES, Grinding
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Machinists' Hand, including Center, Cutter Clearance, Drill Point, Drill Size, Planer, Radius, Screw Pitch, Taper Telescoping Thickness
Brown & Sharpe Mfg. Co., Providence, R. I.

GAGES, Multiple Inspection
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Plug and Ring
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.
Van Keuren Co., Watertown, Mass.
Winter Bros. Co., Rochester, Mich.

GAGES, Roll Thread Snap, Adjustable Snap
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

GAGES, Surface Roughness
DoAll Co., Des Plaines, Ill.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, VERNIER, Height, Depth, Gear Tooth
Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Starrett, The L. S., Co., Athol, Mass.

GEAR BURNISHERS
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHAMFERING, ROUNDING AND DEBURRING MACHINES
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHECKING EQUIPMENT
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES Bevel and Spiral
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Worm and Worm Wheels
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR GRINDERS—See Grinding Machines, Gear

GEAR HOBBERS
American Schiess Corp., 1232 Penn. Ave., Pittsburgh 22, Pa.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

GEAR HONERS
National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.

GEAR LAPPERS
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 12, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

GEAR MOTORS—See Speed Reducers

GEAR RACKS
Gear Specialties, Inc., 2635 W. Medill Ave., Chicago 47, Ill.
Illinois Gear & Mch. Co., 2108 No. Natchez Ave., Chicago 35, Ill.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Stahl Gear & Mch. Co., The, 3901 Hamilton Ave., Cleveland 4, Ohio

GEAR SHAPERS
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

GEAR SHAVERS
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.

GEARS, AND GEAR BLANKS, Nonmetallic
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Gear Specialties, Inc., 2635 W. Medill Ave., Chicago 47, Ill.

(*Continued on page 258*)

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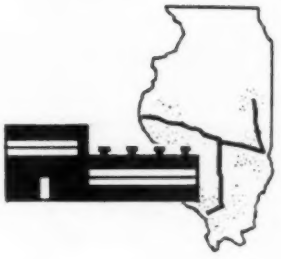

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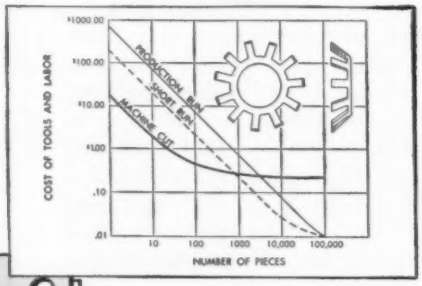

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New Jersey Gear & Mfg. Co., Hillside, N. J.
Ryerson, Jos. T. & Son, Inc., 16th and Rockwell St., Chicago 8, Ill.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio

GEARS, Cut

Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Gear Specialties, Inc., 2635 W. Medill Ave., Chicago 47, Ill.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
Horsburg & Scott Co., 5114 Hamilton, Cleveland, Ohio
Illinois Gear & Mch. Co., 2108 No. Natchez Ave., Chicago 35, Ill.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
New Jersey Gear Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.

GENERATORS, Electric

Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio

GRADUATING MACHINES

Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.

GREASES—See Lubricating Oils and Greases

GRINDERS, Bench, Floor and Snag

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Jones & Lamson Mch. Co., Springfield, Vt.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
U. S. Burke Machine Tool Div., Brotherton Rd., Cincinnati 27, Ohio

GRINDERS, Carbide Tool

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Elox Corp. of Mich., Royal Oak 3, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City, N. J.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

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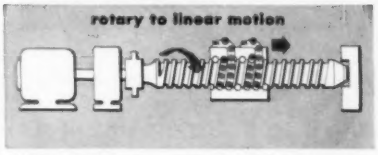
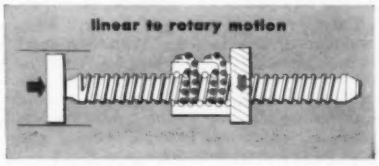


NUT TRAVELS: When rotary motion is applied to the screw, the b/b nut glides along the axis of the screw on rolling steel balls, converting rotary force and motion to linear force and motion with 4/5 less torque than acme screws.



SCREW TRAVELS: When rotary motion is applied to the b/b nut, the screw glides along its longitudinal axis on rolling steel balls, converting rotary force and motion to linear force and motion with unprecedented efficiency.

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ball bearing Screw

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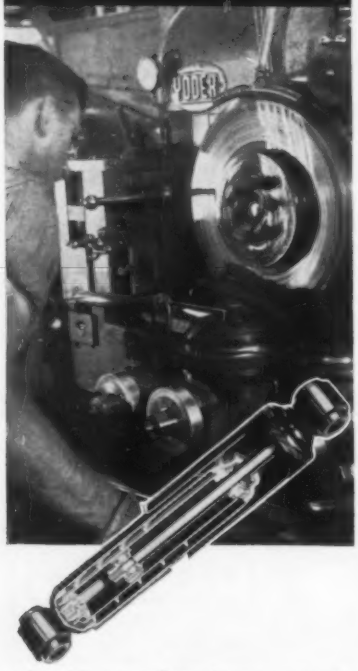
Monroe Shock Absorbers rely on Precision Performance of YODER TUBE MILLS



After 15 years of continuous operation the Yoder Type-M Electric-Resistance Weld Tube Mill shown here, is still producing precision tubing for the Monroe Auto Equipment Co., Monroe, Michigan. Yoder produced tubing is the basic component of the famous "Monro-Matic" shock absorber. Measuring 2 1/64" outside diameter (plus several other sizes) the tubing is made from 22 gauge strip in one continuous operation . . . it is automatically cold-roll formed, welded and cut to pre-determined lengths.

This typical installation of a Yoder tube mill exemplifies the accuracy, dependability and production economies of Yoder-made tubing. If your business requires pipe or tubing, ferrous or non-ferrous, in sizes from 1/4" to 26" diameters, there is a Yoder mill designed to produce it economically, efficiently and accurately.

THE YODER COMPANY
5504 Walworth Ave. • Cleveland 2, Ohio

Check into the many cost-saving advantages of operating a Yoder pipe or tube mill . . . write for the fully-illustrated 88-page Yoder Tube Mill Book . . . it is yours for the asking.

ENGINEERING YODER MANUFACTURING — PIPE AND TUBE MILLS (ferrous or non-ferrous)

GRINDERS, Die and Mold
Norton Co., 1 New Bond St., Worcester 6, Mass.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Drill Point
Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

GRINDERS, Face Mill
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Mattison Machine Works, 545 Blackhawk Park Ave., Rockford, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

GRINDERS, Knife and Shear
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Portable Electric
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Precise Products Corp., 3751 Blue River Rd., Racine, Wis.
Standard Electrical Tool Co., 2488-90 River, Cincinnati 4, Ohio

GRINDERS, Portable Pneumatic
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Madison-Kipp Corp., Madison, Wis.
Onsrud Machine Works, Inc., 7720 Lehigh Ave., Niles, Ill.

GRINDERS, Tap
Ex-Cell-Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.

GRINDERS, Tool and Cutter
Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Barber-Colman Co., Rock and Montague, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Elox Corp. of Mich., Royal Oak 3, Mich.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.
Hamco Machines, Inc., 93 Mt. Hope Ave., Rochester 20, N. Y.
Landis Tool Co., Waynesboro, Pa.
LeBlond, R. K., Mch. Tool Co. Madison and Edwards Rds., Cincinnati 18, Ohio
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

GRINDERS, Toolpost
Cosa Corp., 305 Lexington Ave., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING GAGES—See Gages, Grinding

GRINDING MACHINES, Abrasive Belt
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Mch. Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Broach
Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich.
Gallmeyer & Livingston Co., 336 Straight, S. W. Grand Rapids 2, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder, 1534 W. Main, Springfield, Ohio

GRINDING MACHINES, Cam
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Mch. Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Centerless
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.
Van Norman Mch. Co., Springfield, Mass.

GRINDING MACHINES, Crankshaft
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Mch. Co., Springfield, Mass.

GRINDING MACHINES, Cylindrical
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids, 2, Mich.
Landis Tool Co., Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio
Van Norman Co., 2640 Main St., Springfield 7, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tools Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Works, Rockford, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

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BALL AND ROLLER
bearings

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Mch. Co., 3901 Christopher St., Detroit 11, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Internal

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co. 2488-90 River Rd., Cincinnati, Ohio
Van Norman Mch. Co., Springfield, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES, Jig

Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

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American Laubscher Corp., Fisk Bldg., 250 W. 57 St., New York 19, N. Y.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32 Mich.
Jones & Lamson Mch., Springfield, Vt.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.

GRINDING MACHINES, Surface Reciprocating

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Elox Corp. of Mich., Royal Oak 3, Mich.
Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8 Ohio
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids, 4, Mich.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Van Norman Mch. Co., Springfield, Mass.

GRINDING MACHINES, Surface Rotary

Blanchard Machine Co., 64 State St., Cambridge, Mass.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Van Norman Mch. Co., Springfield, Mass.
Walker, O. S., Co., Inc., Worcester, Mass.

GRINDING MACHINES, Thread

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Machine Co. (Centerless), Waynesboro, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Universal

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Parker-Majestic, Inc., 147 Joseph Campau, Detroit, Mich.

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DoAll Co., Des Plaines, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING WHEELS

Bay State Abrasive Co., Westboro, Mass.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cincinnati Milling Products Div., Cincinnati 9, Ohio
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Gardner Machine Co., Beloit, Wis.
Metal Carbides Corp., Youngstown, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony and Fraley St., Bridgesburg, Philadelphia, Pa.

GROOVING TOOLS, Internal

Waldes Kohinoor, Inc., 47-16 Austrel Place, Long Island City 1, N. Y.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

HAMMERS, Drop—See Forging Hammers

HAMMERS, Portable Electric

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HAMMERS, Portable Pneumatic

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HAMMERS, Power

Chambersburg Engrg. Co., Chambersburg, Pa.
Edlund Mchry. Co. Div., Cortland, N. Y.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

HARDENING FURNACES

Holcraft & Co., 6545 Epworth Blvd., Detroit 10, Mich.

HARDNESS TESTERS

Shore Instrument & Mfg. Co., 90-35C Van Wyck Exp. Jamaica 35, N. Y.
Wilson Mechanical Instrument Div., 230 Park Ave., New York 17, N. Y.

HEAT-TREATING EQUIPMENT—See Annealing Furnaces, Flame Hardening Machines, Induction-heating Equipment

HOBS

Barber-Colman Co., Rock and Montague, Rockford, Ill.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio
National Twist Drill & Tool Co., Rochester, Mich.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

HOISTS, Air

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HOISTS, Electric

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HONING MACHINES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Jes-Cal Co., Fraser, Michigan
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.
Van Norman Mch. Co., 3640 Main St., Springfield 7, Mass.

HONING STONES

Barnes Drill Co., 814 Chestnut St., Rockford,
Jes-Cal Co., Fraser, Michigan
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
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American Metal Hose Br. American Brass Co., 25 Broadway, New York, N. Y.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

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Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Bethlehem Steel Corp., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.

(*Continued on page 264*)

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see these NEW DoALL BAND MACHINES

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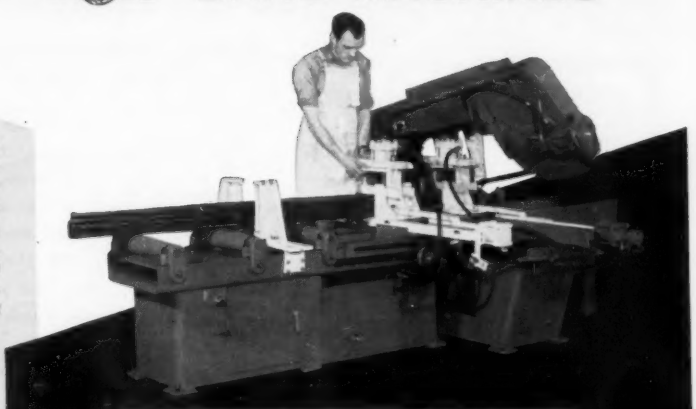

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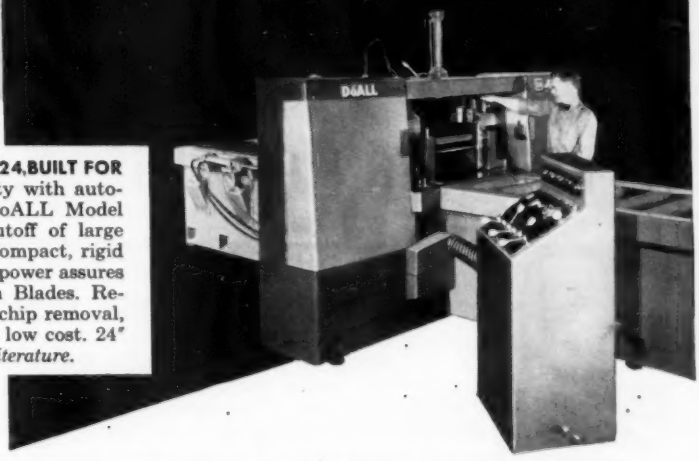

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PS-12

THE DoALL COMPANY, Des Plaines, Ill.

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Bliss, E. W., Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engrg. Co., Chambersburg, Pa.
Colonial Broach & Machine Co., P.O. Box 37, Harper Sta., Detroit 13, Mich.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Denison Engrg. Co., 1160 Dublin St., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., Erie, Pa.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Engrg. Corp., Kenmore Station, Buffalo, N. Y.
Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave., Detroit 4, Mich.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Vickers Incorporated, Div. of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Watson-Stillman Co., 565 Blossom Rd., Rochester 10, N. Y.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

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Barnes, W. F. & John Co., 201 S. Waterford St., Rockford, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Av., Cincinnati 29, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Michigan Drill Head Co., Detroit 34, Mich
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Incorporated, Div. of Sperry Rand Corporation, 1402 Oakman Blvd., Detroit, Mich.

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Austin Industrial Corp., White Plains, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit 39, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Van Norman Mch., 3640 Main St., Springfield 7, Mass.
Vinco Corp., 9111 Schaefer Highway, Detroit, Mich.

INDICATOR BASES, Magnetic

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoAll Co., Des Plaines, Ill.
Starrett, L. S. Co., Athol, Mass.

INDICATOR LIGHTS—See Lights, Indicator

INDICATORS, Dial

Ames, B. C., Waltham 54, Mass.
Brown & Sharpe Co., Providence, R. I.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Federal Products Corp., P. O. Box 1027, Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
National Automatic Tool Co., S. 7th-N Sts., Richmond, Ind.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, The L. S. Co., Athol, Mass.

INDICATORS, Speed

Brown & Sharpe Mfg. Co., Providence, R. I.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Starrett, The L. S., Co., Athol, Mass.

INDICATORS, Surface Plate

Rahn Granite Surface Plate Co., Dayton 7, Ohio

INDICATORS, Test

Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., P. O. Box 1027, Providence, R. I.
National Automatic Tool Co., S. 7th & N Sts., Richmond, Ind.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, The, L. S., Co., Athol, Mass.

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Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Lepel High Frequency Laboratories, Inc., Woodside 77, N. Y.
Ohio Crankshaft Co., 3800 Harvard Ave., Cleveland, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

INSPECTION EQUIPMENT, Ultrasonic

Curtiss-Wright Corp., Caldwell, N. J.

INTENSIFIERS, Hydraulic

Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis.
Watson Stillman Co., 565 Blossom Rd., Rochester 10, N. Y.

JACKS, Planer—See Set-up Equipment

JIG BORERS

American Sip Corp., 100 E. 42nd St., New York 17, N. Y.
Columbia International Corp., Long Island City, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., 450 Fair Ave., Ferndale, Detroit 20, Mich.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
M. B. I. Export & Import, Ltd., 475 Grand Concourse, New York 51, N. Y.
Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

JIG and FIXTURE PARTS

Northwestern Tool & Eng. Co., 117 Hollier Ave., Dayton 3, Ohio

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Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Columbus Die Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Metal Carbides Corp., Youngstown 12, Ohio
Robbins, Omer E. Co., 24800 Plymouth Rd. Detroit 39, Mich.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

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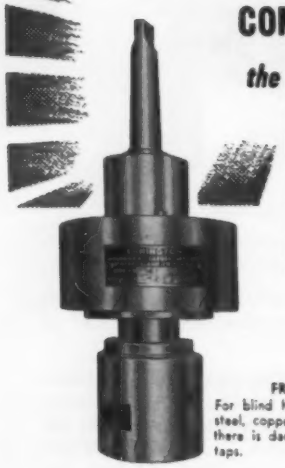

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For blind holes, tapping in steel, copper, etc. wherever there is danger of breaking taps.

QUICK-CHANGE
Tool-Holders to Drill, Tap and Set Studs, etc., without moving work, or stopping or reversing machine. Individual friction adjustment in each tap-holder, if required.

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For through holes where work is drilled and then re-handled and tapped.

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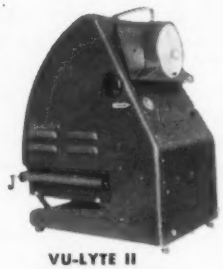
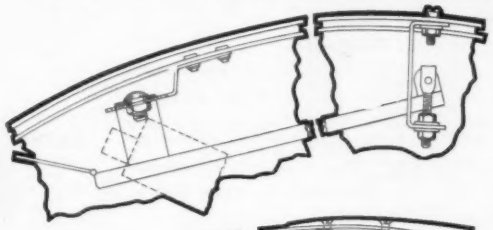
Charles Beseler Co., E. Orange, N. J. uses Waldes Truarc Retaining Rings in 3 applications shown.

REFLECTING MIRROR ASSEMBLY IN OPAQUE PROJECTOR

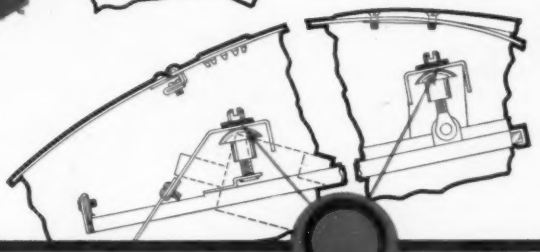


VU-LYTE II PROJECTOR



BEFORE

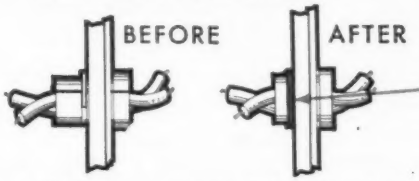
"The front surface mirror is the most precise optical element in a properly-functioning opaque projector," Beseler writes. "Previously we used this extremely cumbersome means of holding the mirror in position. As mirror adjustments are always required and the mirror is extremely delicate, our spoilage was terrific."



AFTER

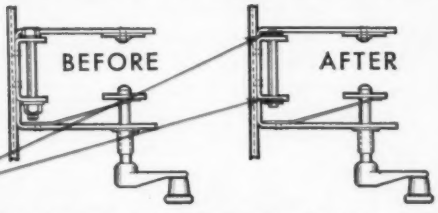
"Two Truarc Series 5100 Rings made possible complete redesign of the mirror assembly. Now mirrors can be adjusted from *outside* the projector. Rejects now are practically nil. More precise adjustment of the mirror is possible. And because of the greater ease in adjustment, we have cut labor costs $2.00 per unit."

HEAT ASSEMBLY IN PRINT DRIER



Here a Waldes Truarc crescent ring, Series 5103, replaced a split collar and clamping ring. Results: labor costs cut 50¢ per unit because of greater ease of assembly. Drier provides more uniform heating.

35 MM MICRO-FILM NEGATIVE CARRIER IN ENLARGER



2 Waldes Truarc Series 5133 E-Rings replaced 2 cap nuts—at a saving of 20¢ per unit in labor costs.

Whatever you make, there's a Waldes Truarc Ring designed to save you material, machining and labor costs, and to improve the functioning of your product.

In Truarc, you get

Complete Selection: 36 functionally different types. As many as 97 standard sizes within a ring type. 5 metal specifications and 14 different finishes. All types available quickly from leading OEM distributors in 90 stocking points throughout the U. S. and Canada.

Controlled Quality from engineering and raw materials through to the finished product. Every step in manufacture watched and checked in Waldes' own modern plant.

Field Engineering Service: More than 30 engineering-minded factory representatives and 700 field men are at your call.

Design and Engineering Service not only helps you select the proper type of ring for your purpose, but also helps you use it most efficiently. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.

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RETAINING RINGS

WALDES KOHINOOR, INC.
47-16 AUSTEL PLACE, L. I. C. 1, N. Y.

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Please send new, descriptive catalog showing all types of Truarc rings and representative case history applications. *(Please print)*

Name .....
Title .....
Company .....
Business Address .....
City ..... *Zone* ... *State* .....

M050

WALDES TRUARC-Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

For more information fill in page number on Inquiry Card, on page 179

KEYSEATERS
Baker Bros., Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Bliss, E. W. Co., Canton, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Mitts & Merrill, 1809 S. Water St., Saginaw, Mich.
Morton Mfg. Co., Muskegon Hts., Michigan

KNURLING TOOLS
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

LAPPING MACHINES
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio.
Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill. (Lapmaster Div.)
Do-All Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gleason Works, 1000 University Ave., Rochester, N. Y.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.

LATHE ATTACHMENTS
Atlas Press Co., Kalamazoo, Mich.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch., 512 Clinton St., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.

LATHES, AUTOMATIC—See Chucking Machines

LATHES, Axle
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Consolidated Mch. Tool Div., Farrel-Birmingham Co., Inc., Rochester 10, N. Y.
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sunstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Bench
Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Levin, Louis & Son, Los Angeles 21, Calif.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Car Wheel
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Bullard Co., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.

LATHES, Copying, Duplicating — See Lathes, Duplicating

LATHES, Crankshaft
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Double-End
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

LATHES, Duplicating
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Sidney Machine Tool Co., Sidney, Ohio

LATHES, Engine, Manufacturing
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Atlas Press Co., Kalamazoo, Mich.
Barber-Colman Co. (Hendey Mch. Div.), Rockford, Ill.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Engine, Toolroom
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Atlas Press Co., Kalamazoo, Mich.
Barber-Colman Co. (Hendey Mch. Div.), Rockford, Ill.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Logan Engineering Co., 4901 Lawrence Ave., Chicago 30, Ill.
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kiswaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Gap
Atlas Press Co., Kalamazoo, Mich.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio

LATHES, Hollow Spindle
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
South Bend Lathe Works Inc., 425 E. Madison St., South Bend, Ind.

LATHES, Roll
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati 2, Ohio
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Bliss, E. W., Co., Canton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio

LATHES, Speed, Second-operation
Atlas Press Co., Kalamazoo, Mich.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., Cincinnati 25, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Lodge & Shipley Co., The, Cincinnati 25, Ohio

LATHES, Toolroom—See Lathes, Engine, Toolroom

LATHES, Turret, Automatic
Atlas Press Co., Kalamazoo, Mich.
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.

LATHES, Turret, Ram Type, Saddle Type
Atlas Press Co., Kalamazoo, Mich.
Bardons & Oliver Inc., Ft. W. 9th St., Cleveland 13, Ohio
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave., Elmira, N. Y.

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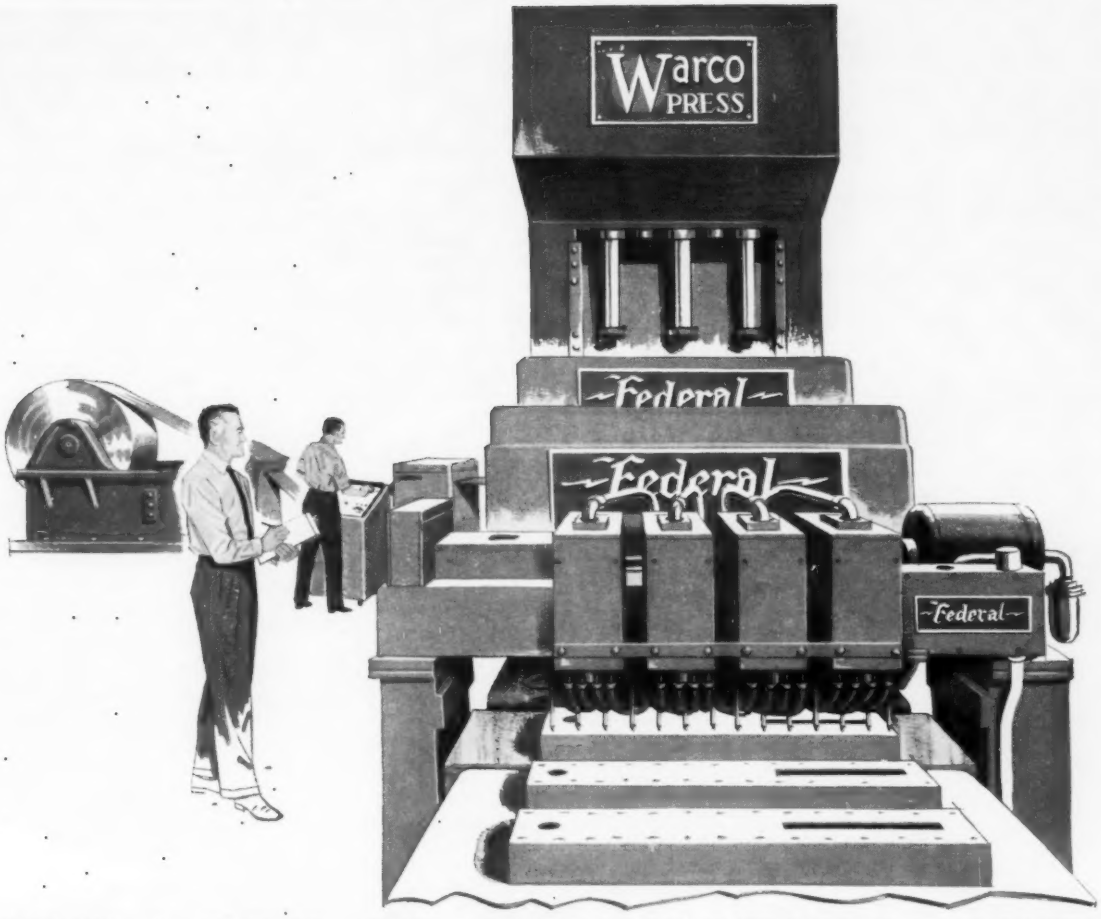

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Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Lavin & Son, Inc., Louis, Los Angeles 8, Calif.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mach. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

LATHES, Turret Vertical—See Boring Mills, Vertical

LAYOUT and DRAFTING TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Lufkin Rule Co., Saginaw, Mich.
Starrett, L. S., Co., Athol, Mass.

LEVELS
Lufkin Rule Co., Saginaw, Mich.
Starrett, The L. S., Co., Athol, Mass.

LIMIT SWITCHES—See Switches, Limit

LUBRICATING OILS and GREASES
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan, Chicago, Ill.
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia, Pa.
Texas Co., 135 E. 42nd St., New York, N. Y

LUBRICATING SYSTEMS
Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave. Chicago 23, Ill.
Madison-Kipp Corp., Madison, Wis.

MACHINERY, Used and Rebuilt
Eastern Mchry. Co., 1000 Tennessee Ave., Cincinnati, Ohio
Miles Mchry. Co., 2025 E. Genessee Ave., Saginaw, Mich.
Van Keuren Co., Watertown 72, Mass.
Williams, J. H., & Co., 400 Vulcan St., Buffalo 7, N. Y.

MACHINISTS' SMALL TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Lufkin Rule Co., Saginaw, Mich.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Starrett, The, L. S., Co., Athol, Mass.

MANDRELS—See Arbors and Mandrels

MARKING MACHINES and DEVICES
Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MATERIAL-HANDLING TRUCKS—See Trucks, Material Handling

MEASURING MACHINES
Lufkin Rule Co., Saginaw, Mich.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio,
Van Keuren Co., Watertown 72, Mass.

MEASURING WIRES—Thread, Spline, Gear
Sheffield Corp., Dayton 1, Ohio
Treadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Van Keuren Co., Watertown 72, Mass.

MICROMETER HEADS
Brown & Sharpe Mfg. Co., 235 Promenade St. Providence 1, R. I.
DoAll Co., Des Plaines, Ill.
Starrett, The L. S., Co., Athol, Mass.

MICROMETERS, Outside, Inside, Depth
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Lufkin Rule Co., Saginaw, Mich.
Scherr, George, Co., Inc., 200 Lafayette St. New York 12, N. Y.
Starrett, The, L. S., Co., Athol, Mass.
Van Keuren Co., Watertown 72, Mass.

MICROSCOPES, Toolmakers'
Bausch & Lomb Optical Co., Rochester, N. Y
DoAll Co., Des Plaines, Ill.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St New York 12, N. Y.

(Continued on page 270)

from **to** **in 9 seconds**

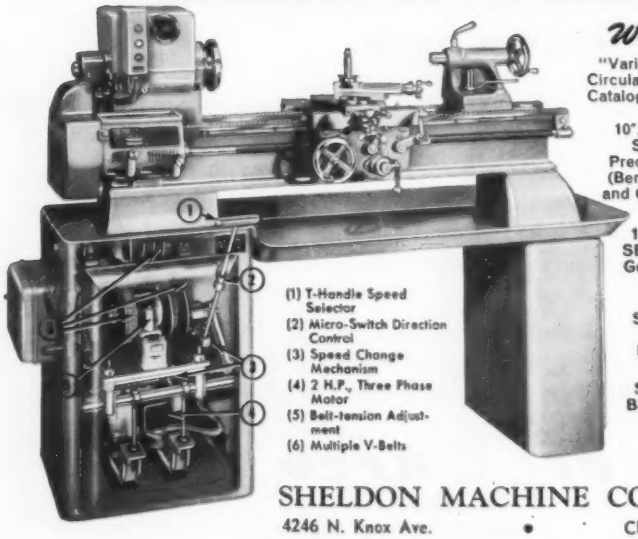
or to *any* intermediate speed, *instantly*

Just raise or lower the T-handle control, and watch the large tachometer dial in the headstock! It's that easy! The work is done by a power driven speed changer. It accelerates or slows the lathe to any desired speed in seconds. With a 10:1 ratio, this new variable drive makes it easy to select from a wide range of speeds —200 to 2000 rpm in direct drive and 40 to 300 rpm in back gear.

Maximum stability and smooth power transmission are assured because the drive unit is oversized. All pulleys and shafts are fully supported (eight bearings). Double V-belts throughout the drive eliminate slippage and deliver full power to the spindle. Because of this rigidity and extra pulling power, this lathe will take heavy cuts at all speeds and precision finish cuts at high speeds.

It is a precision lathe, moderate in price, with the versatility for toolroom, production or second operation jobs.

SHELDON *Variable Speed* **PRECISION LATHES**


(1) T-Handle Speed Selector
(2) Micro-Switch Direction Control
(3) Speed Change Mechanism
(4) 2 H.P., Three Phase Motor
(5) Belt-tension Adjustment
(6) Multiple V-Belts

Write for
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10", 11" and 13" SHELDON Precision Lathes (Bench, Pedestal and Cabinet types)
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•
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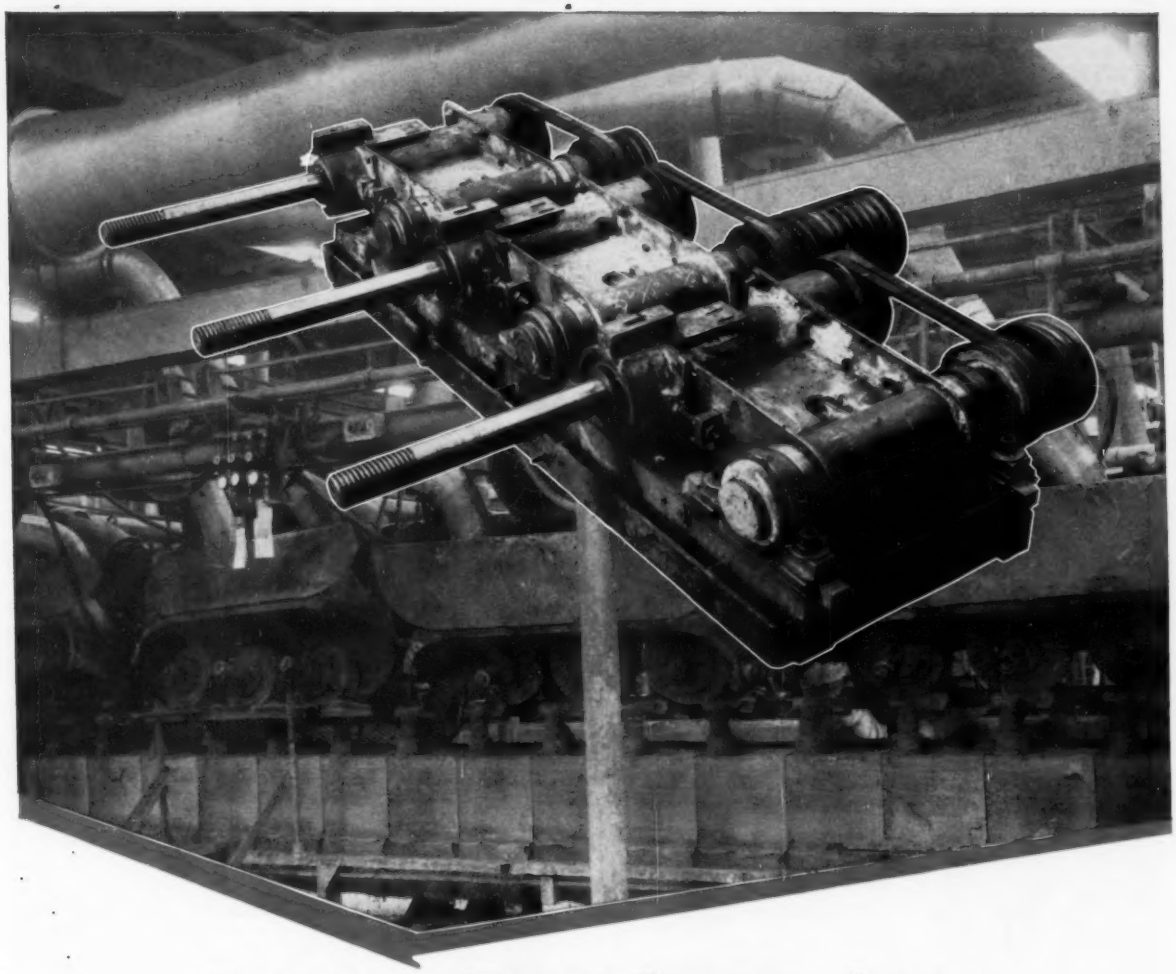
SHELDON MACHINE CO., INC.
4246 N. Knox Ave. • Chicago 41, Ill.



Here's a Bearings, Inc. idea that saved our customer $3,000 in labor, maintenance and parts in 7 months

Only an authorized bearing distributor such as Bearings, Inc., with the experience and facilities we have at our disposal, could have designed and supplied the special housings that hold the flinger sealed bearings that now have effectively solved this difficult bearing maintenance problem.

A well known automotive stamping plant designed and built this tandem buffing head (shown above) for its own use. Due to the extremely high concentration of metal dust from the buffing and polishing wheels conventional bearings had a very short life. Over 300 bearings were purchased in 7 months. Downtime due to bearing failure was very costly. The actual labor and material cost of replacing the bearings during this period exceeded $3,000! Since the new bearing units designed by Bearings, Inc. (shown enlarged) were installed, no bearing failures have occurred and no replacements have been installed.

Remember Bearings, Inc. when you need replacement bearings — Get "factory fresh" bearings of latest design and manufacture. We are *authorized* to sell most famous makes of bearings. We sell *only* those we are authorized to distribute. Call the Bearings, Inc. branch nearest you!

Providing bearing service in the North ➤ **BEARINGS, INC.**

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INDIANA: Ft. Wayne • Indianapolis • Muncie • Terre Haute • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York
WEST VIRGINIA: Charleston • Huntington • Parkersburg • Wheeling • **NEW JERSEY:** Camden
NEW YORK: Buffalo, Balanrol Corp. • **MARYLAND:** Baltimore • **DELAWARE:** Wilmington

and in the South ➤ **DIXIE BEARINGS, INC.**

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N. CAROLINA: Charlotte • Greensboro • **S. CAROLINA:** Greenville • **TENNESSEE:** Chattanooga • Kingsport • Knoxville • Nashville

For more information fill in page number on Inquiry Card, on page 179

MILLING MACHINE ATTACHMENTS

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George, Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Van Norman Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Automatic

Cincinnati Milling Machine Co., Cincinnati, Ohio
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Nichols, W. H. Co., Waltham 54, Mass.
Onsrud Machine Works, Inc., 7720 Lehigh Ave., Niles, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.

MILLING MACHINES, Bed Type, Simplex, Duplex

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Cincinnati Milling & Grinding Mches., Inc., 470 Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Wrks., Front St. and Girard Ave., Philadelphia, Pa.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Onsrud Machine Works, Inc., 7720 Lehigh Ave., Niles, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.
Van Norman Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Bench, Hand

Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.

MILLING MACHINES, Circular, Continuous

Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Nichols, W. H. Co., Waltham 54, Mass.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

MILLING MACHINES, Die Sinking, Duplicating, Profiling

Arrow Engineering Co., Inc., 120 E. Market St., Indianapolis, Ind.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Colonial-Romulus Div., Parkgrove Station, Detroit 5, Mich.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp., of Mich., 1830 Stephenson Highway, Royal Oak 3, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Onsrud Machine Works, Inc., 7720 Lehigh Ave., Niles, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Knee Type, Horizontal, Plain, Universal

Austin Industrial Corp., 76 Mamaroneck Ave., White Plains, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Ferndale, Mich.
Gorton, Geo., Mch., Co., 1110 W. 13th St., Racine, Wis.
Greaves Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Onsrud Machine Works, Inc., 7720 Lehigh Ave., Niles, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheldon Machine Co., Inc., 4240-5258 N. Knox Ave., Chicago 41, Ill.
Van Norman Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

MILLING MACHINES, Knee Type Ram

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Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Turret

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.

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Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
Gorton, George, Mch. Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

MILLING MACHINES, Planer Type

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Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.

(Continued on page 272)

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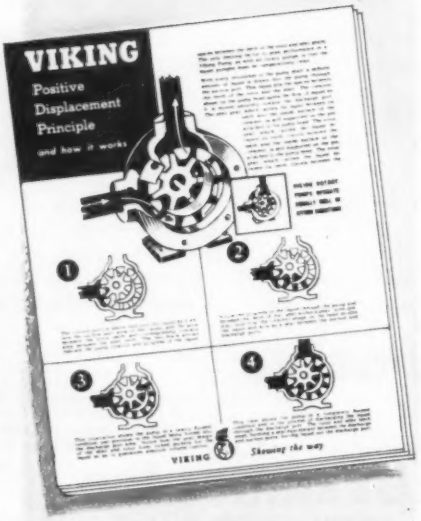

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Onsrud Machine Works, Inc., 7720 Lehigh Ave., Niles, Ill.
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Cross Co., 3250 Bellevue, Detroit 7, Mich.
Federal Prod. Corp., 1144 Eddy St., Providence 1, R. I.
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(Continued on page 274)

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Clearing Mch. Corp., 6499 W. 65th St., Chicago 38, Ill.
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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
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Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
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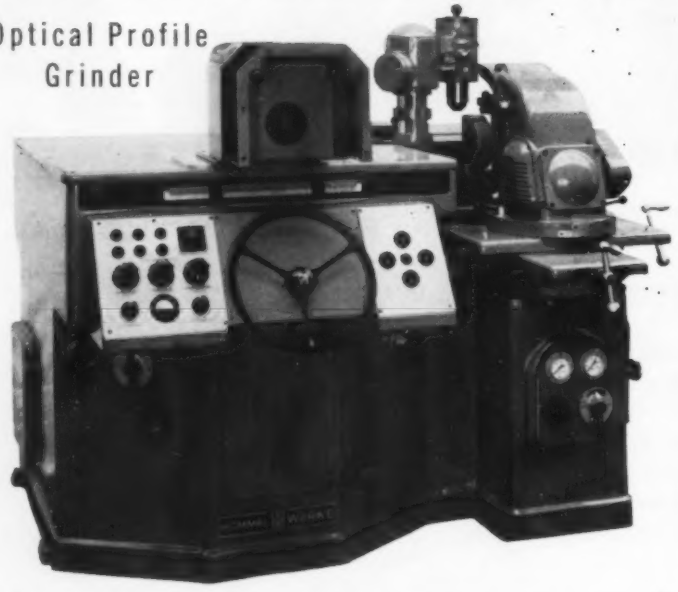

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Nilson, A. H. Machine Co., Bridgeport, Conn.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., East Orange, N. J.

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(*Continued on page 276*)

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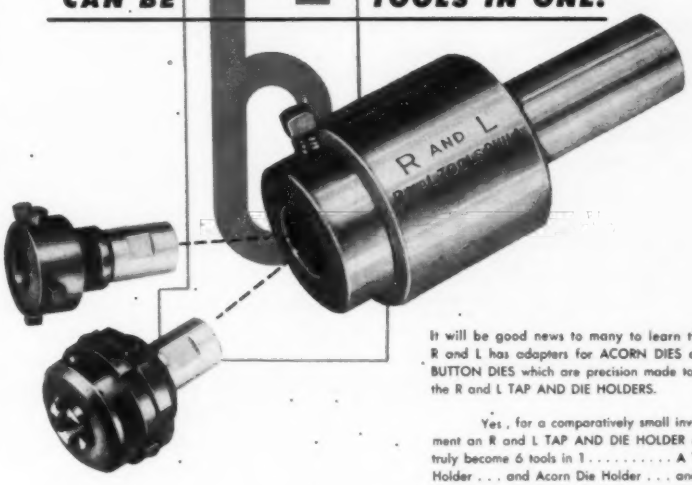

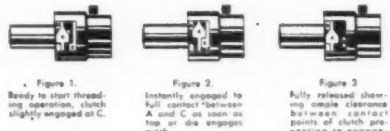

Figure 1. Ready to start threading operation, clutch slightly engaged at C.

Figure 2. Instantly engaged to full contact between A and C as soon as tap or die engages work.

Figure 3. Fully released showing ample clearance between contact points of clutch preventing re-engagement or hammering of clutch points in case turret advances slightly after clutch releases.

* By substituting a shorter clutch ring retaining nut this tool can be readily changed for cutting extra short threads.

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Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
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Dake Corp., 604 Monroe St., Grand Haven, Mich.
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Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
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Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave. Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Drawing

Alva Allen Industries, Clinton, Missouri
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Cincinnati Milling & Grinding Machines, Inc., 4710 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6399 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Extrusion

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Foot

Famco Machine Co., Kenosha, Wis.
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Horning

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.

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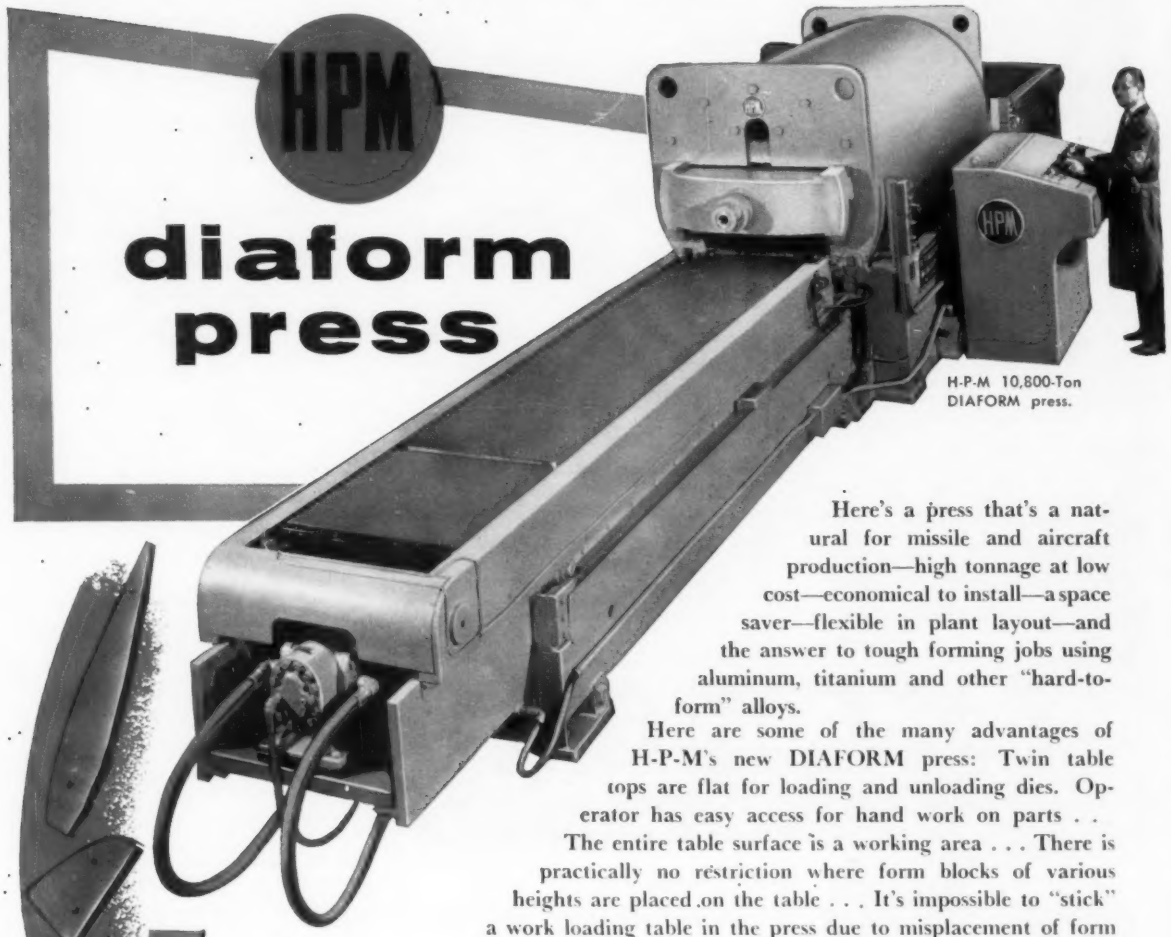

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Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PRESSES, Notching

Alva Allen Industries, Clinton, Missouri
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit Corp., Akron, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Punching, Piercing

Alva Allen Industries, Clinton, Missouri
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Famco Machine Co., Kenosha, Wis.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Co., 509 S. Wolf Rd., Des Plaines, Ill.
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood, Chicago 19, Ill.
Wales-Strippit Co., Akron, N. Y.
Walsh Press & Die Co., 4709 W. Kinzie St., Chicago 44, Ill.
Wiedemann Machine Co., 4272 Wissahicken Ave., Philadelphia 32, Pa.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Quenching

Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Gleason Wks., 1000 University Ave., Rochester 3, N. Y.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

PRESSES, Rubber-Forming

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Cincinnati Milling & Grinding Machines, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hannifin Co., 509 S. Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Trimming

Alva Allen Industries, Clinton, Missouri
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Co., 509 S. Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood, Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PROFILING MACHINES—See Milling Machines, Die Sinking, etc.

PROTECTORS, Thread & Tube

Maybrun, A. E. Co., 920 Ripley St., Santa Rosa, Calif.

PULLEYS

Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.

PUMPS, Coolant and Lubricant

Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Graymills Co., 3705 N. Lincoln Ave., Evanston, Ill.
Ingersoll-Rand Co., Phillipsburg, N. J.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Ruthman Machinery Co., 1809 Reading Rd., Cincinnati 2, Ohio
Viking Pump Co., Cedar Falls, Iowa

PUMPS, Hydraulic

American Engineering Co., Wheatsheaf Lane & Sepviva St., Philadelphia 37, Penna.
Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Denison Engrg. Co., 1160 Dublin St., Columbus
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Vickers Incorporated, Division of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Viking Pump Co., Cedar Falls, Iowa
Wilson, K. R., Inc., Arcade, N. Y.

PUNCHES AND DIES—See Dies, Blanking, etc.

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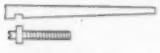

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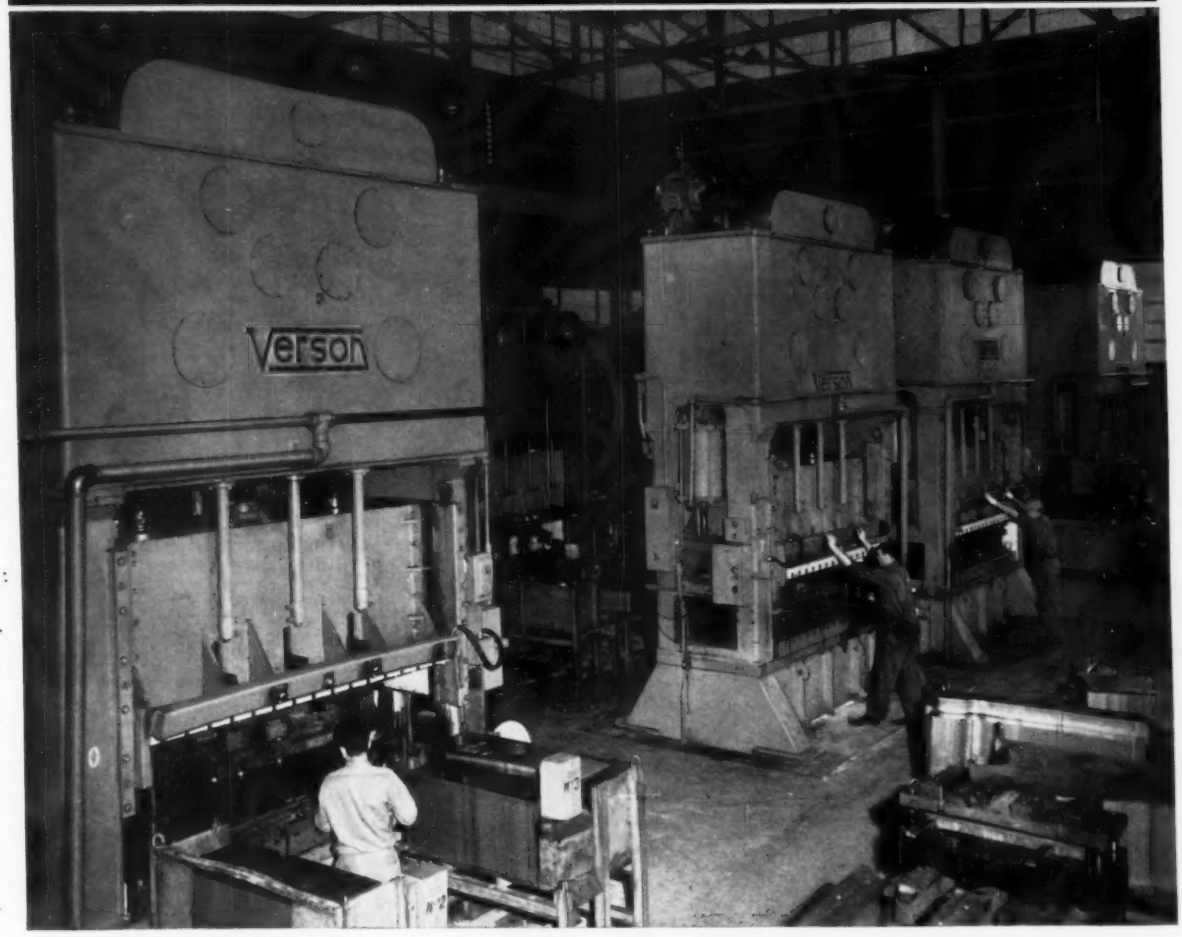

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Cleveland Twist Drill Co., 1242 49th St., Cleveland, Ohio
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., & Winter Bros. Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

REELS, Stock
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.

REFRACTORS Heat-Treating Furnaces
Norton Co., 1 New Bond St., Worcester 6, Mass.

RETAINING RINGS FOR BEARINGS, etc.
Bearings, Inc., 3634 Euclid Ave., Cleveland, Ohio
Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y.

RIVETERS, Portable
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Hannifin Co., 509 S. Wolf Rd., Des Plaines, Ill.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

RIVETERS, Stationary
Brown & Sharpe Mfg. Co., 35 Promenade St., Providence 1, R. I.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Hannifin Co., 509 S. Wolf Rd., Des Plaines, Ill.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

ROTARY TABLES, OPTICAL
Machine Products Corp., 6771 E. McNichols Rd., Detroit 12, Michigan

RULES, SCALES AND STRAIGHTEDGES
See Machinists' Small Tools

RUST INHIBITORS
Kasenit Co., Mahwah, N. J.
Oakite Products, Inc., 19 Rector St., New York, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.

SAND BLAST EQUIPMENT—See Blast Cleaning Equipment

SAW BLADES, Hack, Band, Circular Friction
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Capewell Mfg. Co., 60 Governor St., Hartford, Conn.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Espen-Lucas Mach. Works, Philadelphia, Pa.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Starrett, The L. S., Co., Athol, Mass.
Tonnewitz Works, Grand Rapids, Mich.

SAW BLADE SHARPENERS
DoAll Co., Des Plaines, Ill.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.

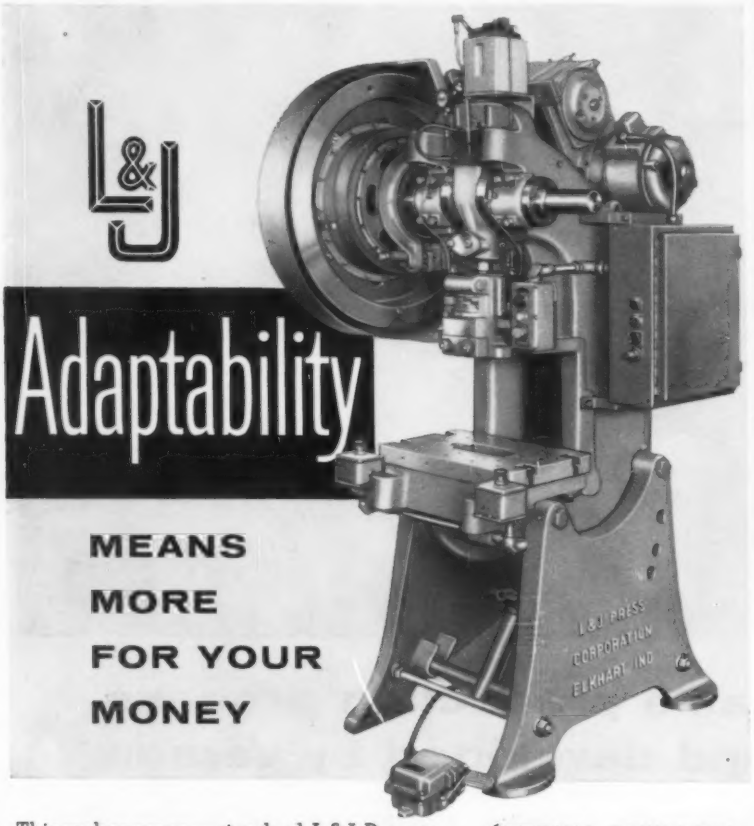
SAWING MACHINES, Abrasive Machines—See Cutting-off Saws, Abrasive Wheel

SAWING MACHINES, Band
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Cutron Mfg. Co., Lubbock, Texas
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Famco Machine Co., Kenosha, Wis.
Tannewitz Works, Grand Rapids, Mich.

SAWING MACHINES, Circular Blade
Consolidated Mch. Tool Div., Blossom Road Rochester 10, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., 614G N. Lexington Ave., Pittsburgh 8, Pa
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.

SAWING MACHINES, Power Hack
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Chicago Pneumatic Tool Co., New York 17 N. Y.

SAWS, Screw-slotting—See Cutters, Milling



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Chicago Pneumatic Tool Co., 6 E. 44th St. New York, N. Y.
Cleco Air Tools, P. O. Box 2119, Houston, Texas
Consolidated Mch. Tool Div., Blossom Road. Rochester 10, N. Y
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Errington Mech. Lab, Inc., 24 Norwood Ave. Staten Island 4, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4 N. Y.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.

SCREW MACHINES, Hand—See Lathes, Turrett, Ram-type, Saddle-type

SCREW MACHINES, Single-Spindle Automatic

Brown & Sharpe Mfg. Co., Providence, R. I
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Cone Automatic Mch. Co., Inc., Windsor, Vt
Cosa Corp., 405 Lexington Ave., New York 17 N. Y.
Gear Grinding Mch. Co., 3901 Christopher St. Detroit 11, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave. Madison 10, Wis.
Gorton, George, Mch. Co., 1110 W. 13th St., Racine, Wis.
National Acme Co., 170 E. 131st St., Cleveland. Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

SCREW MACHINES, Multiple-Spindle Automatic

Cone Automatic Mch. Co., Inc., Windsor, Vt.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Greenlee Bros. & Co., 2136 12th St., Rockford Ill.
National Acme Co., 170 E. 31st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Schrrr, George Co., Inc., 200 Lafayette St New York 12, N. Y.
Warner & Swasey, 6701 Carnegie Ave., Cleveland 3, Ohio

SCREW PLATES

Greenfield Tap & Die Corp., Greenfield, Mass.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

SCREWS, Cap, Set, Self-tapping, etc.—See Bolts, Nuts and Screws

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Bearings, Inc., 3634 Euclid Ave., Cleveland, Ohio
Crane Packing Co., 1800 Culver Ave., Chicago, Ill.
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago, Illinois

SEPARATORS, Magnetic

Barnes Drill Co., 814 Chestnut St., Rockford Ill.
Sundstrand Mch. Tool Co. 2531 11th St Rockford, Ill.

SET-UP EQUIPMENT

Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Lufkin Rule Co., Saginaw, Mich.
Northwestern Tool & Eng. Co., 117 Hollier Ave Dayton 3, Ohio
Starrett, The L. S., Co., Athol, Mass.

SHAPERS, Crank and Hydraulic

Austin Industrial Corp., 76 Mamaroneck Ave White Plains, N. Y.
Cincinnati Shaper Co., Elam and Garrard Aves. Cincinnati, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St. Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

SHAPERS, Vertical and Slotters

Austin Industrial Corp., 76 Mamaroneck Ave White Plains, N. Y.
Bridgeport Mches., Inc., 500 Lindley St. Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road Rochester 10, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St. Rockford, Ill.

SHEARS, Alligator

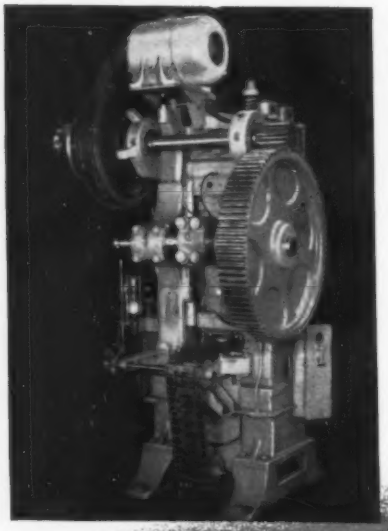
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio

SHEARS, Rotary

Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Simonds Saw & Steel Co. (Knives), 470 Main St., Fitchburg, Mass.

SHEARS, Squaring

Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Cincinnati Shaper Co., Elam and Garrard Aves. Cincinnati, Ohio
Famco Machine Co., Kenosha, Wis.
Lodge & Shipley Co., The Cincinnati 25, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Simonds Saw & Steel Co. (Blades), 470 Main St., Fitchburg, Mass.



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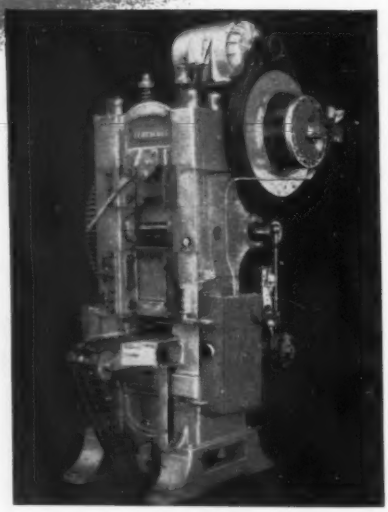
E-401 EMBOSSING PRESS ELIMINATES EXPENSIVE MILLING OPERATIONS FOR AUTOMOTIVE MANUFACTURER

Ferracute Embossing Press E-401, 400 ton model



Produces rocker arms for intake and exhaust valves two at a time—30 strokes per minute—total production 3,600 pieces per hour. Ferracute top toggle, tie-rod construction Embossing Presses are available in a complete range of sizes from 150-ton to 1,500-ton. Ruggedly constructed and extremely powerful, these presses may often be used to move the metal cold and thus replace costly milling operations.

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Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

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SOCKETS—See Drill Sleeves and Extension Holders

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Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F & John Co., 201 S. Water St., Rockford, Ill.
Baush Machine Tool Co., 156 Wason Ave., Springfield 7, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Blanchard Mch. Co., 64 State St., Cambridge, Mass.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
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Chambersburg Engrg. Co., Chambersburg, Pa.
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio
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Greenlee Bros. & Co., 12th and Columbia Aves., Rockford, Ill.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Kingsbury Mch. Tool Corp., Keene, N. H.
Lake Erie Engrg. Corp., Kenmore Station, Buffalo, N. Y.
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National Acme Co., 170 E. 131st St., Cleveland, Ohio
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National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio
National Twist Drill & Tool Co., Rochester, Mich.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Robbins, Omer E. Co., 24800 Plymouth Rd.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Sundstrand Mch. & Tool Co., 2531 11th St Rockford, Ill.
Universal Engrg. Co., Frankenmuth 2, Mich.
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.
Waltham Machine Works, Newton St., Waltham, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

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Boston Gear Works, 320 Main St., North Quincy 71, Mass.

(*Continued on page 284*)

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Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N. St., Richmond, Ind.
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Metallizing Eng. Co., Westbury, L. I., N. Y.

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Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

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STEEL, Cold Rolled, Stainless, High-speed, Tool, etc.
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Bethlehem Steel Co., Bethlehem, Pa.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Timken Roller Bearing Co., Canton, Ohio
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Landis Mch. Co., Waynesboro, Pa.
Threadwell Tap & Die Co., Greenfield, Mass.

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Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

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Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

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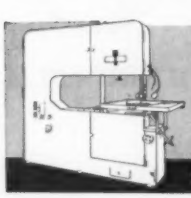

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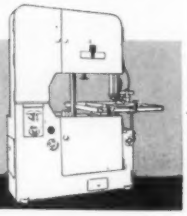

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Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Boice-Crane Co., Toledo, Ohio
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Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Leland-Gifford Co., 1425 Southbridge St., Worcester, Mass.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

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Cincinnati Bickford Div. of Giddings & Lewis Mch. Tool Co., Oakley, Cincinniati 9, Ohio.
Chicago Pneumatic Tool Co., New York 17, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Edlund Machinery Co., Cortland, N. Y. Ohio
Elox Corp. of Mich., 1830 Stephenson Highway, Royal Oak 3, Mich.
Hamilton Tool Co., 834 S. 9th St., Hamilton Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Kaufman Manufacturing Co., Manitowac, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Landis Mch. Co., Waynesboro, Pa.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio
Zagar, Inc., 2400 Lakeland Blvd., Cleveland 23, Ohio

TAPS, Hand, Machine Screw, Pipe, etc.

DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio.
Threadwell Tap & Die Co., Greenfield, Mass.
Winter Bros. Co., Rochester, Mich.

TAPS, Collapsing

Geometric Tool Co. Div., Greenfield Tap & Die Corp., New Haven 15, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

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Davis & Thompson Co., 4460 W. 124th St. Milwaukee 10, Wis.
Errington Mach. Lab. Inc., 24 Norwood Ave., Staten Island 4, N. Y.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Dayton 1, Ohio

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Geometric Tool Co. Div., Greenfield Tap & Die Corp., New Haven 15, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

THREAD ROLLING DIES—See Dies, Thread Rolling

THREAD ROLLING EQUIPMENT

Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Landis Machine Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
National Machinery Co., Tiffin, Ohio
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Dayton 1, Ohio
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Cross Co., 3250 Bellevue, Detroit 7, Mich.
Royal Design & Mfg. Inc., 4133 E. 10 Mile Rd., Centerline, Mich.
Scully-Jones Co., 1906 S. Rockwell St., Chicago 8, Ill.

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Apex Tool & Cutter Co., Inc., Shelton, Conn.
Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cleveland Automatic Mch. Co., 4932 Beech St., Cincinnati 12, Ohio
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
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R & L Tools, 1825 Bristol St., Philadelphia 40, Pa.

(Continued on page 286)

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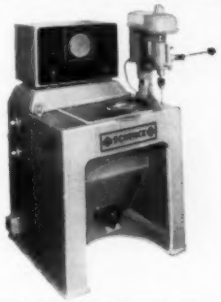
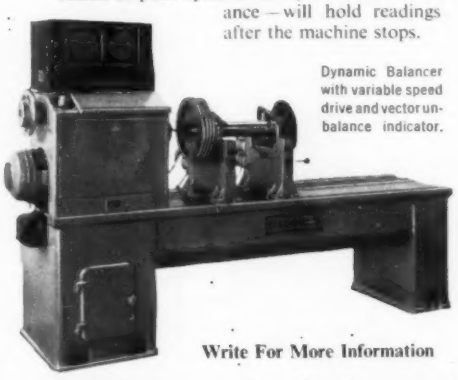


Static Balancer with associated drilling unit.



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Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.

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Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Apex Tool & Cutter Co., Inc., Shelton, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Ill.
Cleveland Twist Drill Co., 5214 W. Armstrong Cleveland, Ohio
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Metal Carbides Corp., Youngstown 12, Ohio
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

TOOL MATERIAL, Ceramic

Metal Carbides Corp., Youngstown 12, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, High-Speed Steel

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Apex Tool & Cutter Co., Inc., Shelton, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio

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Atlas Press Co., Kalamazoo, Mich.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Wales-Strippit Co., Akron, N. Y.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio

TRANSFER MACHINES, Automatic—

See Multiple-Station Machines

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Barnes, John S. Corp., Rockford, Ill.
Boston Gear Wks., Quincy, Mass.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Vickers, Inc., Detroit 32, Mich.

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Ryerson, Jas. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.

TUBING, Steel

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Babcock & Wilcox Co., Beaver Falls, Pa.
National Tube Div., U. S. Steel Corp., 525 Wm. Penn Place, Pittsburgh, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
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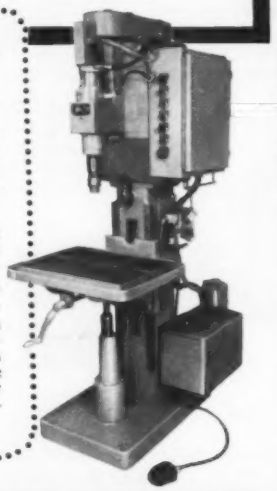
MODEL 25-20 TAPPING MACHINE



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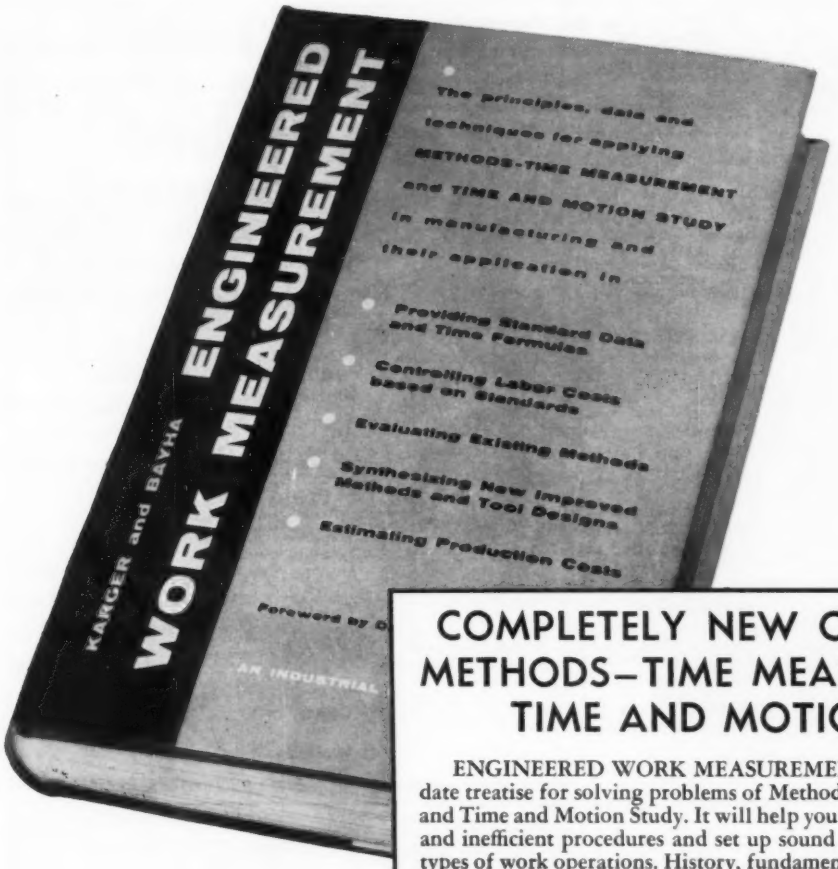
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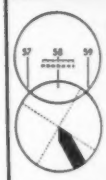

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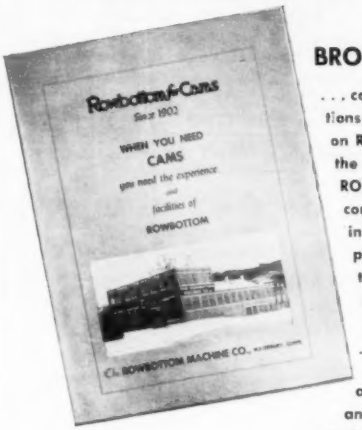

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No. 5 DELX Potter & Johnston, m.d., late
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53" Niles-Heavy Pattern, m.d., p.r.t.
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102" Niles Wheel Turning Boring Mill

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4'—13" col. Fosdick, 1944
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No. 4MS Leland & Gifford H.S., 4 spindle A.C. m.d.
1 spindle No. 2MA6 Avey H.S., m.d., 7½" overhang, 1943
No. 2B-8" H.D. Edlund, H.P., m.d.
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4 spindle No. 15 Buffalo Bench Type
4 spindle Allen H.S., belt drive
4 spindle No. ½ MA8 Avey, H.S., m.d.
4 spindle Demco H.S., individual m.d.
4 spindle No. 2BMA-6 Avey H.S., m.d.
Walker Turner H.S., vee belt drive
5 spindle Allen H.S., belt drive
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Model 410 W. F. & John Barnes, Horizontal Boring & Drilling Machine, m.d.
Natco Horizontal Drill, holesteel model, m.d., 1942
Natco Horizontal Drill, 2 opposed B4F2 Head, 1943
¾"x40" Bausch Double Horizontal Drilling Machine, m.d.
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No. 445 W.F. & John Barnes Independent 2 spindle Deep Hole Drilling & Boring Machine, late

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COMPRESSOR. 455 CFM Ingersoll Rand duplex synchr.
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GEAR SHAPER. 7125A Fellows, 1942
GEAR SHAVER. GCC Red Ring, 8", late
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GRINDER, PLAIN. 20" x 72" Landis, 1943
GRINDER, DISC. 30" No. 84A Gardner opposed, 1947
GRINDER, INT. 72A5 Heald Univ. 1943
GRINDERS, SURF. 36" No. 18 Blanchard, 1940
GRINDER, CARBIDE. Nos. 48 and 49 Excello, late
LATHES. 11" and 14½" South Bend, late
LATHE. 126" x 96 ft. Niles Bement Pond.
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MILL. No. 33 Sundstrand auto. "Fluidscrew", 1943
MILL. No. 2 Brown & Sharpe vert., 1943
MILL. No. 36 Van Norman
OIL GROOVER. Wicaco continuous, 1953.
SAW. 10" x 10" Racine "Shearcut", hack, 1941
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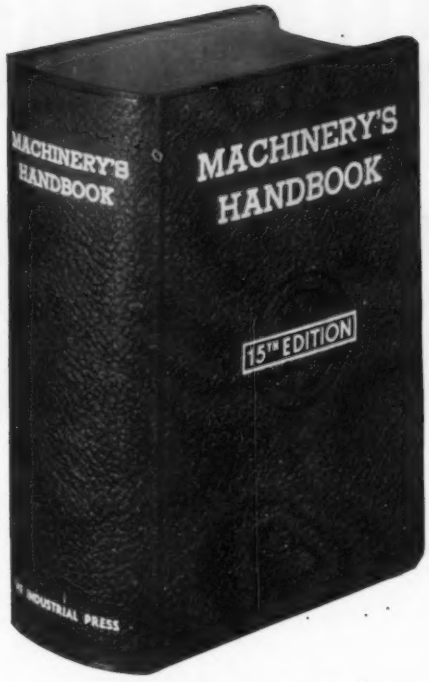

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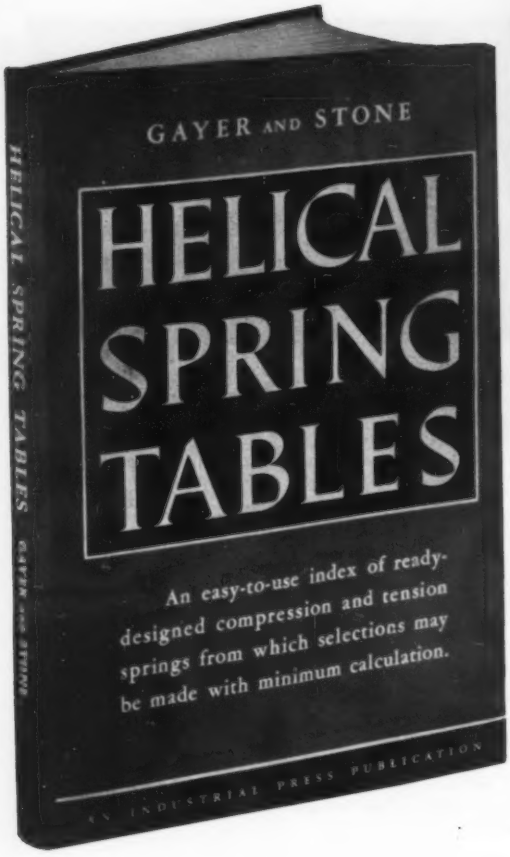
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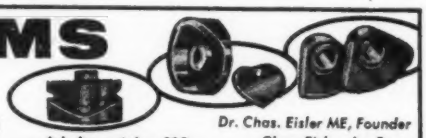

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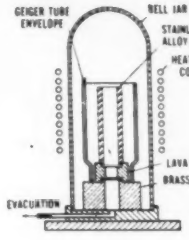

The manufacture of Geiger Tubes requires a vapor coating of stainless steel inside of the glass envelope. The glass envelope is positioned inside of a bell jar which is connected to evacuation equipment. After evacuation, induction heating coil shown in position over bell jar heats the stainless steel source to high temperature causing vaporization. Condensation occurs on glass walls of the tube.

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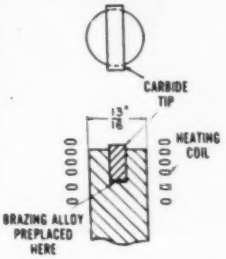

The drawing shows a carbide tip being brazed in the milled recess of a drill. High temperature brazing alloy is preplaced as indicated. Proper spacing of the turns of the heating coil extends the transition zone to avoid metallurgical notch and thereby fatigue failure. In a production set-up, the heating cycle can be preset so that every drill will be uniformly processed.

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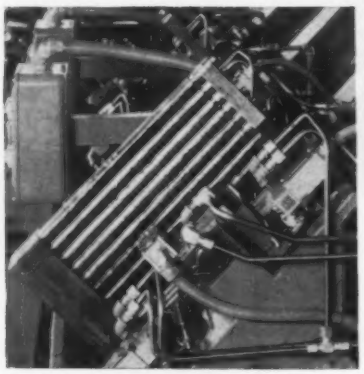

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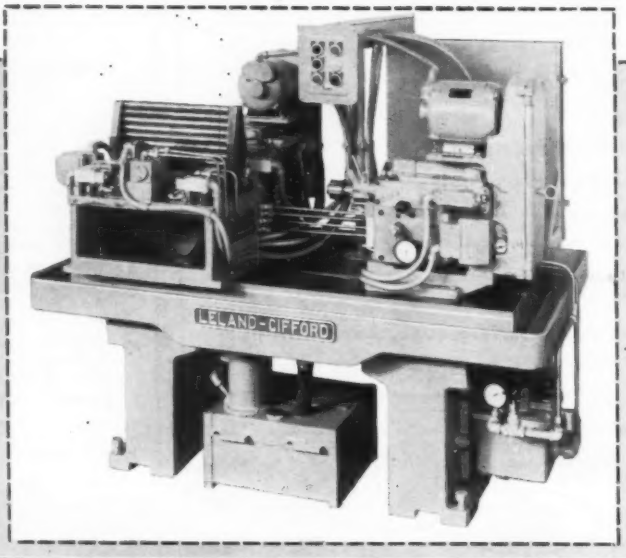

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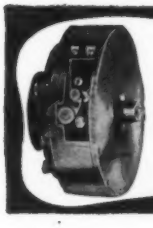

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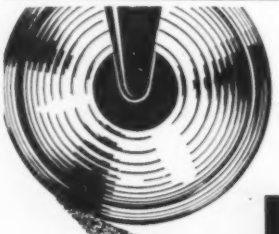

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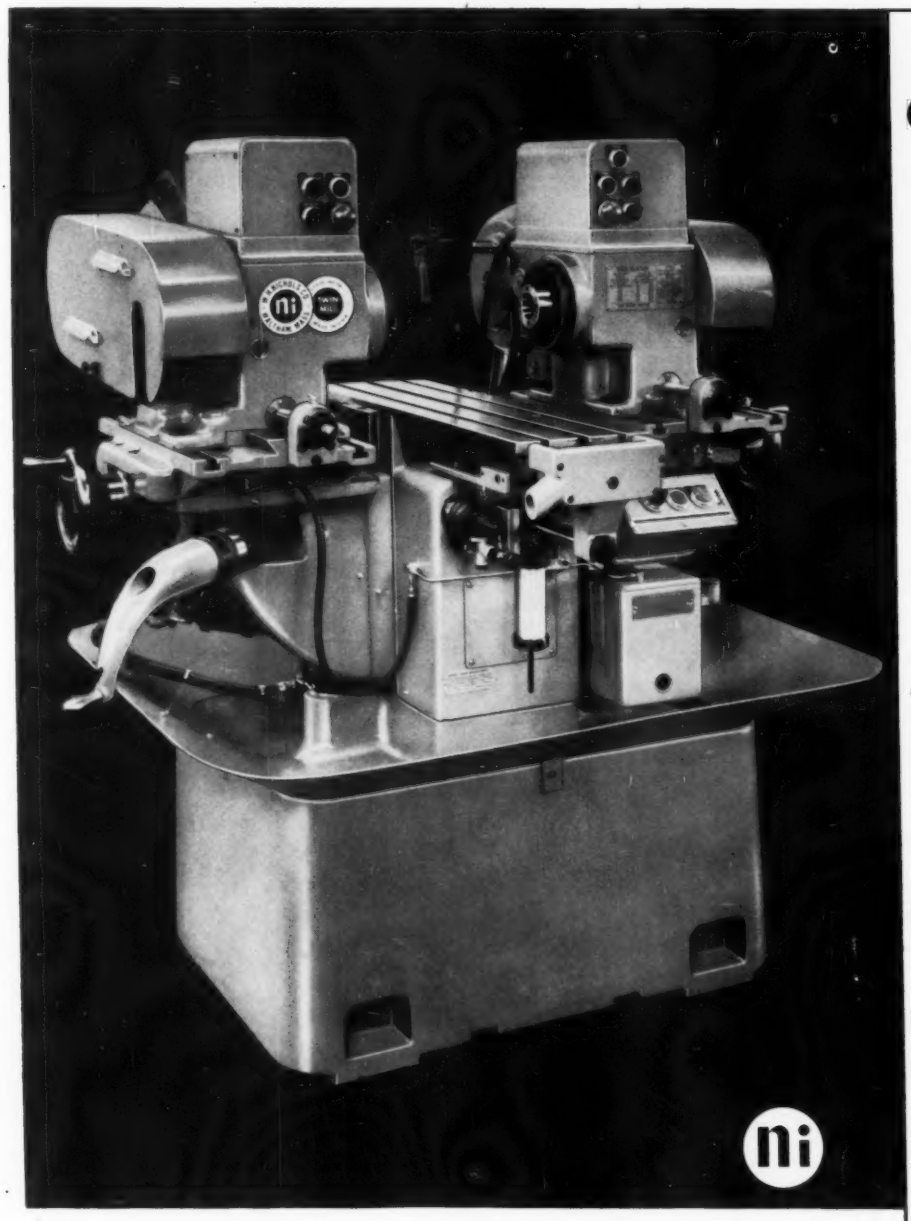

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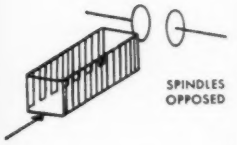

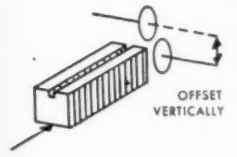

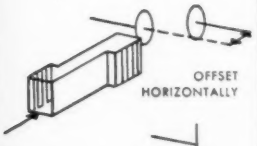

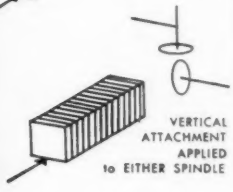

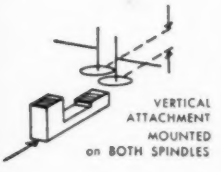

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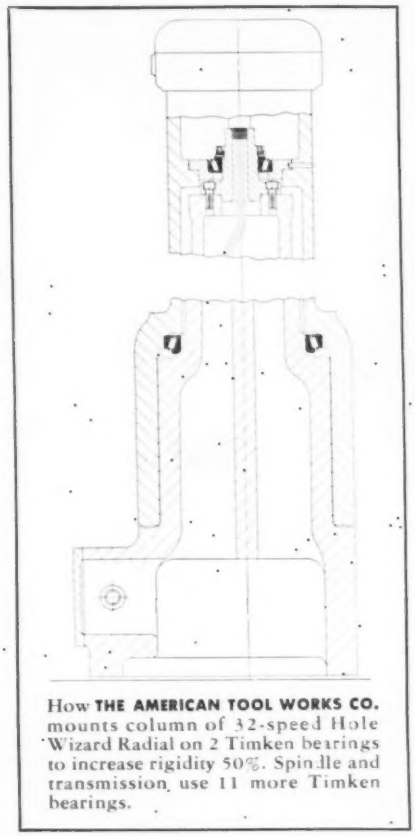

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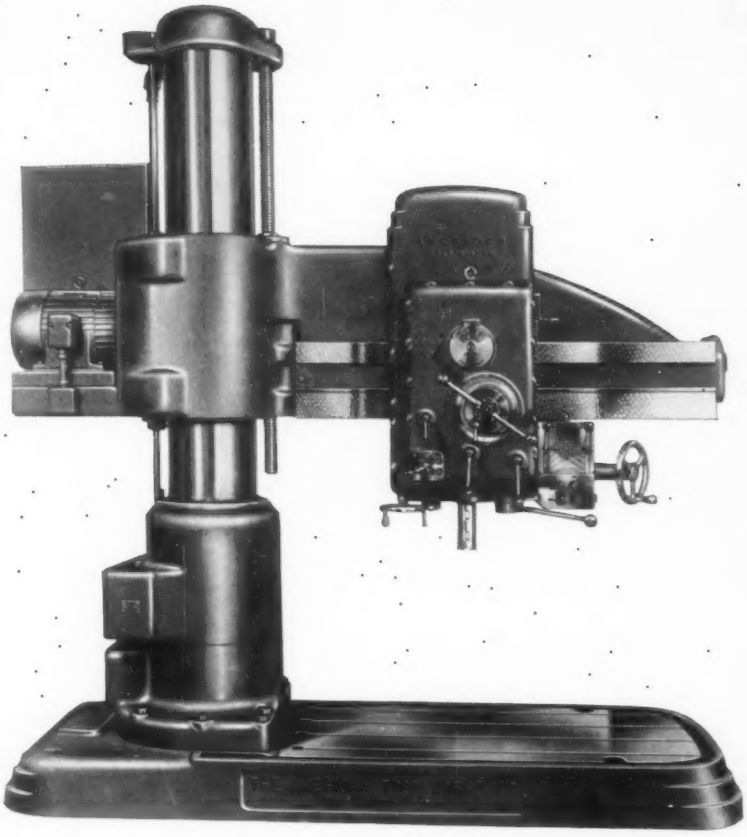

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